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THE MALAYAN AGRICULTURAL JOURNAL

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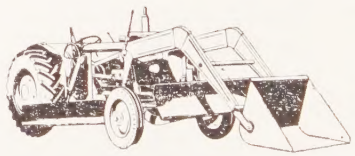

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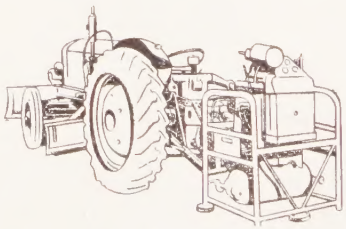

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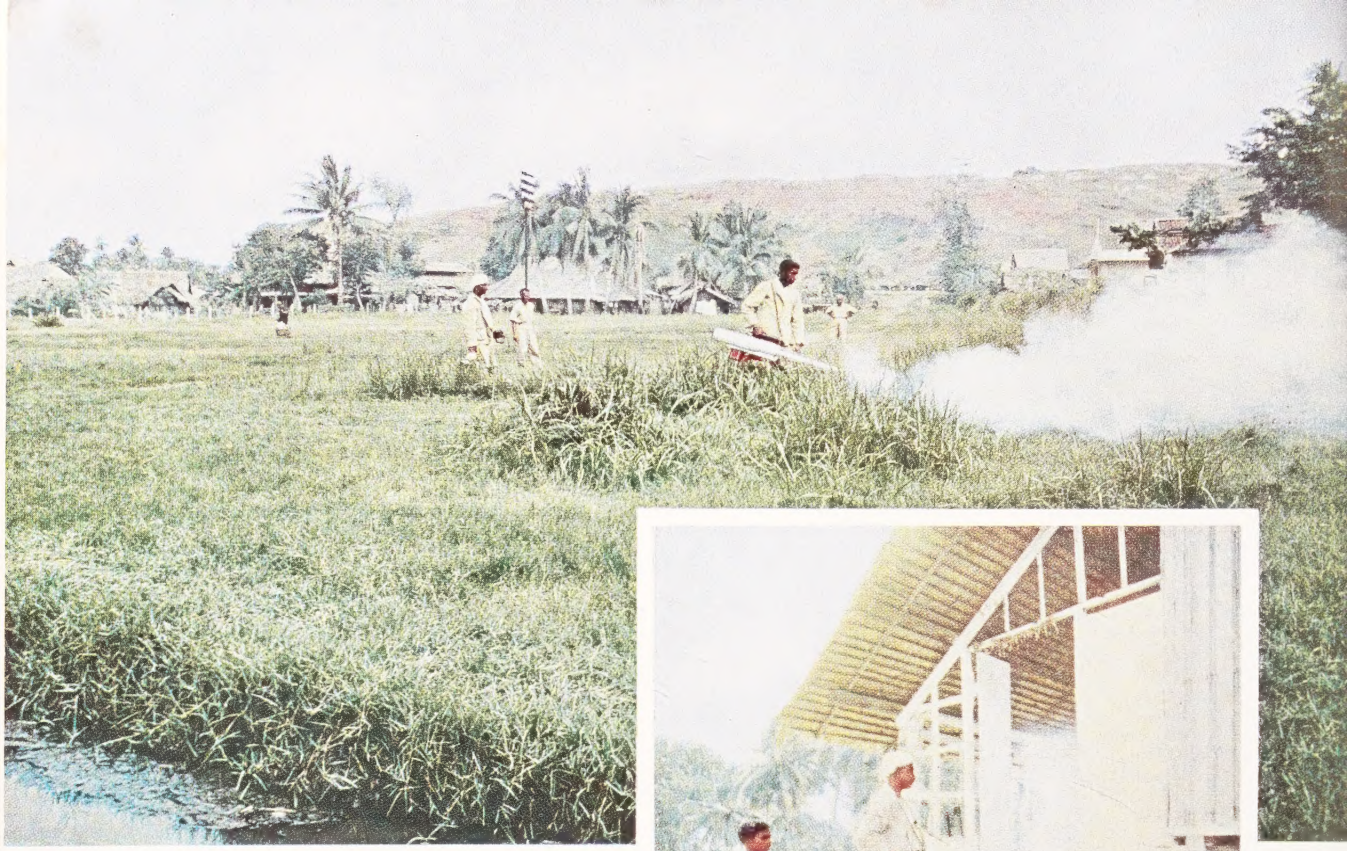

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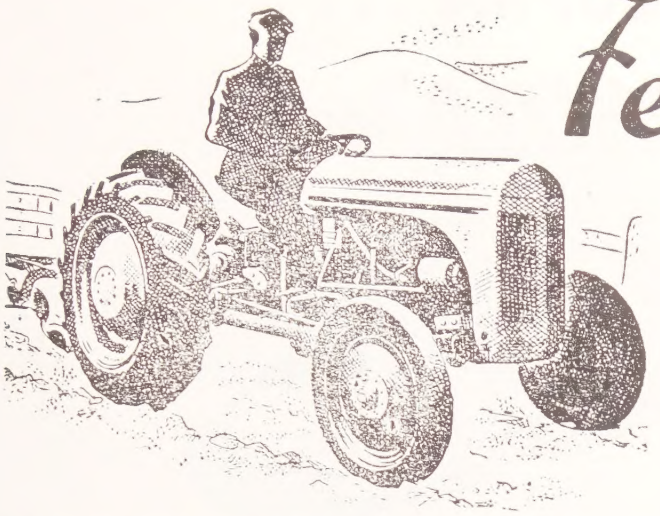

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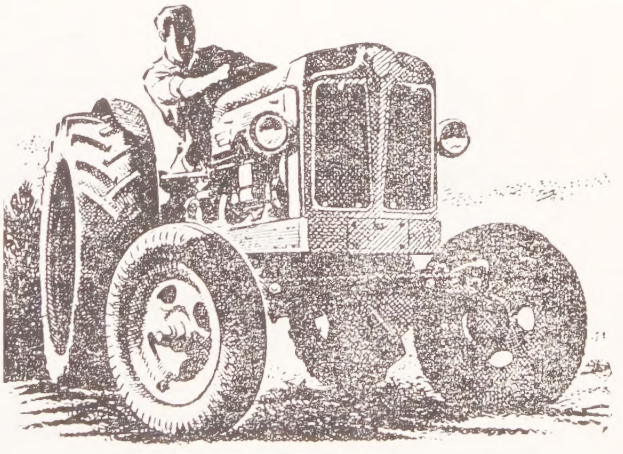

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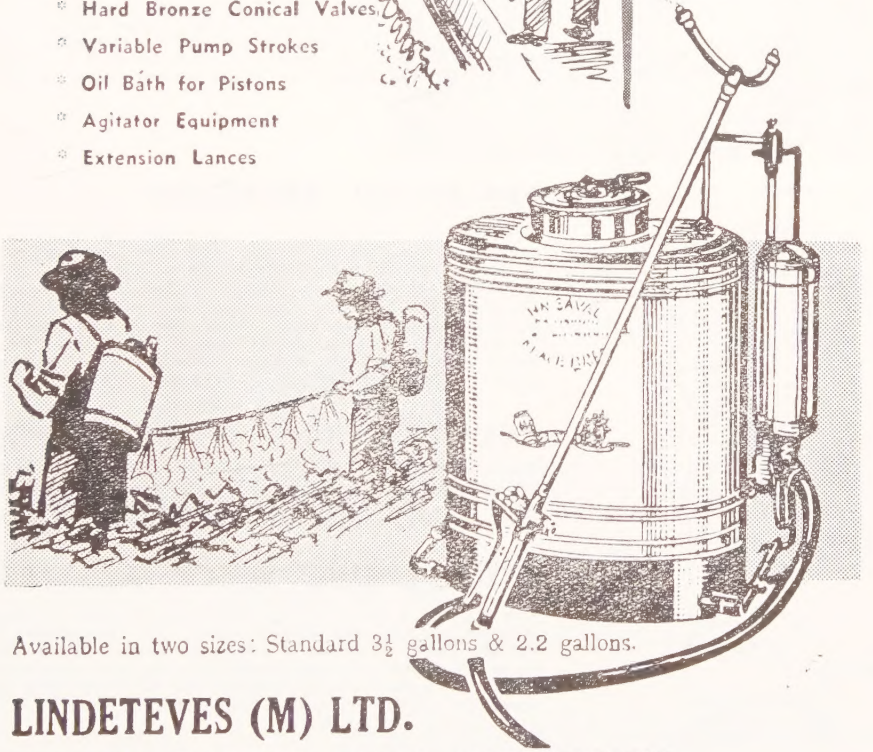

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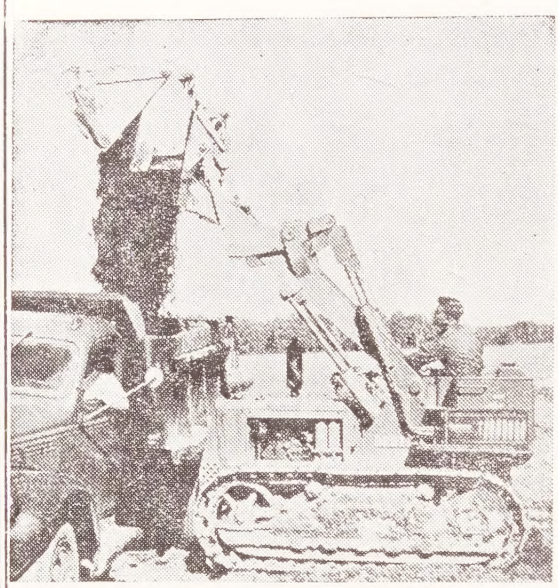

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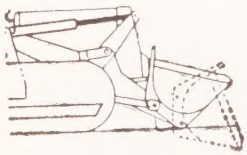

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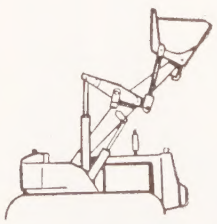

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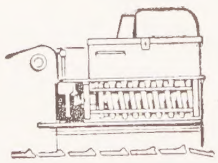

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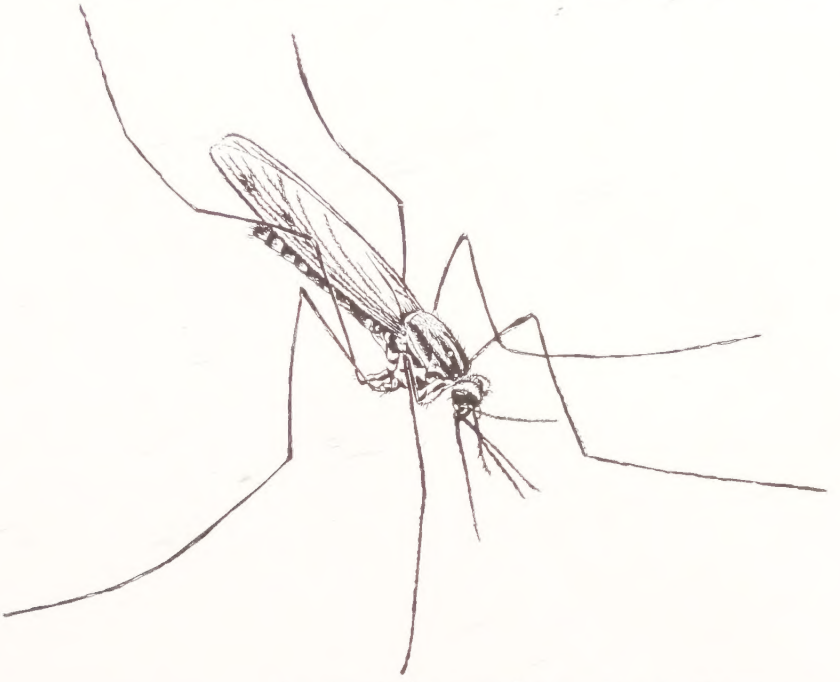

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THE

Malayan Agricultural Journal

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THE MALAYAN AGRICULTURAL JOURNAL

The Journal which is published quarterly, is designed to present — as far as possible in non-technical terms — the results of the agricultural research, investigation and extension work performed by the Department of Agriculture and it draws attention to the results of work of a similar nature in other countries.

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The Journal and other publications may be obtained from the Department of Agriculture, Kuala Lumpur, Federation of Malaya, or from the office of the Commissioner for Malaya in the United Kingdom, 57, Trafalgar Square, London, W.C.2.

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THE

Malayan Agricultural Journal

Vol. 41, No. 1, 1958.

EDITORIAL

The Malayan Agricultural Journal increased in size during 1957; the last issue, like this one, carrying six original articles in addition to those of the new "Master Farmers" series and standard features.

This increase in the number of reports of results achieved in different branches of research and investigation, is the fruition of work carried out by members of the Department over a long period. They cover widely different aspects of Malayan agriculture and together make a significant contribution to world knowledge of tropical crops.

Many of the names familiar to our readers will not appear again, as can be seen from the pages devoted to staff changes. The expert knowledge gained by officers such as these after years of work on agricultural problems in Malaya, many of whom spoke Malay fluently and were familiar with kampong customs and traditions, was unique. It is fortunate that some, at least, of this knowledge is preserved in the pages of this Journal. The contributions that come forward from those who have taken their place will be welcomed and there is no doubt that the high standard of Departmental work reported here will be maintained.

Soil Survey Reports. The seventh report in this series describes the soil features of the Bukit Goh Forest Reserve area, near Kuantan, Pahang, and reveals the potential value of 11,400 acres of highly fertile land, with an additional 2,250 acres of land which would also be suitable for tree crops requiring fairly fertile soil. It is unfortunate that such soils rarely occur under jungle in Malaya, and the factual soil data provided in this report are the more valuable on that account.

Diseases of Padi. Mr. Johnston's clear identification of Malayan padi diseases in this issue is an important contribution, both for specialists and non-specialists. It has been written to assist those engaged in agricultural extension work, and others, to identify the diseases of padi occurring in Malaya. Control measures have been suggested where possible. Because the damage done, for example, by leaf spot and stem rot is not obvious, the importance of disease as a factor in lowering yield per acre is frequently overlooked. This is the first occasion on which a description of these diseases has been published in this country.

Pineapple Leaf Analysis. An excellent piece of research is reported in the article on this subject, which may have an important bearing on the improvement of the Malayan pineapple industry. The technique of leaf analysis is shown to provide a good basis for determining the fertiliser requirement for pineapples and its importance in relation to yield and quality of fruit.

SOIL SURVEY REPORTS. No. 7,

THE BUKIT GOH FOREST RESERVE, NEAR KUANTAN, PAHANG

BY

WM. P. PANTON, *Geologist (Soil Survey)*,

and

ANG TAI JIN, *Agricultural Assistant, Temerloh.*

Introduction

It has been known for many years that the soils in and around the Bukit Goh Forest Reserve, near Kuantan, Pahang, are richer than the great majority of soils occurring in other parts of the Federation of Malaya. As part of the soil survey programme which is being pursued in conjunction with the recent efforts to introduce cacao and other trees crops on smallholdings and estates, particularly along the East Coast, the present survey was carried out to obtain a better idea of the extent of this good soil and the possible variations occurring within it.

The soil survey field work, most of which was carried out by the junior author (A.T.J.), was much simplified by the fact that the whole area had previously been geologically surveyed by Fitch (1) immediately prior to World War II. The good soil is derived mainly from basalt rock, and the boundary of this rock type with the other rocks in the Bukit Goh Forest Reserve was taken as the approximate limit of the area to be soil surveyed. As a result, the field work consisted mainly of checking whether any large differences existed between the soil and rock boundaries along the edge of the area, and examining the main development of good soil for any obvious changes which may have been induced by variations in topography or vegetation.

The soil map which accompanies this report shows with considerable accuracy the boundary of the better soils, and it is suggested that these soils would be quite suitable for certain high-fertility tree crops, including cacao.

Soil-Forming Factors

The factors controlling the type of soil developed over the district are described briefly in the following paragraphs.

CLIMATE

Like most places along the East Coast of Malaya, Bukit Goh is exposed to the full impact of the north-eastern monsoon, between November and February. The intensity of the monsoon varies greatly from year to year and the total rainfall during this season may vary

between 30 and 110 inches. The relative humidity is around 70 per cent during most of the year with average day temperatures of about 82°F. Between March and October the weather is fairly moist, with monthly rainfall varying between less than one inch and up to 20 inches; short dry spells of up to three or four weeks are not uncommon. The figures given above are based on meteorological observations made at Kuantan airport, about eight miles south-west of the Reserve.

GEOLOGY

This has been described in detail by Fitch, whose geological map shows the greater part of the area to be covered by basalt lavas with associated dolerite dykes of lower Tertiary age, which overlie an eroded granite surface. Outcrops of granite rocks occur in several places in the north, centre, and south-east while along the western side of the basalt mass an arenaceous series of rocks, possibly of Triassic age, are exposed.

TOPOGRAPHY

The greater part of the area consists of gently to moderately undulating land rising to about 200 feet and dissected by numerous narrow alluvial flats, through which flow small streams draining into the Sungei Riau towards the south-west. The only steep land is along the eastern and south-eastern boundaries, where several small hills rise to above 400 feet. These hills are mostly flat-topped, but slopes up to 25° are common on the sides, while the valley bottoms are narrow and contain very little alluvium. This type of topography is also found in the rubber estates sited on basalt rock to the east of the mapped area, where the evenness of the hill tops has made it more convenient to build estate roads along the highest points, rather than the valley sides as is the common practice in other parts of the country.

The only extensive swamps are along the western side of the area and in the south-western corner.

VEGETATION

Almost the whole of the Reserve is covered by typical Malayan dipterocarp rain forest. Several areas have been extensively worked for timber, particularly chengal (*Balanocarpus* spp.) and meranti (*Shorea* spp.) at various times in the past, but no felling is at present taking place. The density in growth varies little among trees on the better hill-soils, although the undergrowth tends to be thicker on gently to moderately undulating land and thinner on ridge tops and on steep slopes. A rich swamp flora, which varies in density according to general drainage condition, covers the low-lying alluvial flats and swamps. Small patches of *belukar* (secondary jungle) and *lalang* (*Imperata cylindrica*) are common towards the southern boundary.

Soils

Classification and mapping has been carried out at the series level, where possible, except for two groups of minor importance which

were not examined in detail. One completely new series was found in the area, while the other series have been identified and described previously in various published soil survey reports for other parts of Malaya, to which references are given in the text.

Kuantan Clay

This soil, which was first named and described by Owen (2), is characterised by a well developed granular crumb, dark yellowish-brown (10YR 4/4) subsoil colour, and great depth which, unlike that of most other Malayan soils, permits good root development for several feet below the surface. The parent material is basalt or dolerite, and the soil occurs over moderately undulating to hilly country in that part of the Bukit Goh Forest Reserve shown on the attached map and also in a number of rubber estates lying to the east of the reserve which were not included in the area surveyed.

The soil profile consists of a dark brown (10YR 4/3) clay surface layer, some two or three inches thick, having a strongly developed fine crump structure, excellently drained and aerated, and very well rooted under virgin jungle. This surface horizon is underlain by a deep, uniform clay subsoil which varies in colour from strong brown (7.5YR 5/6) to dark yellowish-brown (10YR 4/4) and is characterised by a medium granular to subangular blocky structure, which when disturbed breaks to a strong fine crumb. Rooting is excellently developed down to four or five feet below the surface, and intermittent rooting often continues to much greater depths. Drainage is rapid even as far down as six or seven feet, but the good water-retaining capacity of the soil crumbs effectively prevents complete drying out to the subsoil even in times of intense drought. The very open structured topsoil however is liable to fairly rapid drying, and this may explain the difficulty in establishing cover crops, and even tree crops, which require several months growth to take place before their tap roots reach the moist lower levels of the profile.

As will be seen from the typical set of analysis results in Table I, this soil displays a reasonably high nutrient level, particularly in the lower parts of the subsoil, which is in sharp contrast with most other Malayan soils which show a rapid drop in nutrient values below the top few inches.

The description given above applies to Kuantan clay developed over moderately to gently undulating land and is typical of the greater part of the area. Over steeper slopes of between 15 and 25°, however, the soil may be brown (7.5YR 4/4) or reddish-brown (5YR 5/4) in colour and slightly shallower in the subsoil. This variant is common only on the eastern side of the surveyed area, in the localities where the ground is most steeply undulating. Other variations within this series include the occurrence of occasional bauxitic laterite concretions at depths of two or more feet and in some cases the development of a continuous band of laterite and iron-stained rock fragments at depths

of three or four feet. This latter phase appears to be very local and confined to the flatter areas on the tops of some of the lower ridges.

Table I

Analysis of Kuantan Clay Profile

Depth (in.)	Clay <.002 mm.	Silt .002 -.02 mm.	Fine sand .02 -.2 mm.	Coarse sand .2-2 mm.	Gravel 2-10 mm.	Stone in Orig. >10 mm.	pH	Loss on Ign.	O.M. %	C %	N %	C/N ratio	Available P p.p.m.	Available K p.p.m.
0- 1	62	16	20	2	Nil	Nil	4.5	21	7.9	4.60	0.31	14.7	10	90
1- 3	63	17	16	4	„	„	4.8	17	4.4	2.56	0.20	12.8	8	45
3- 6	72	19	7	2	„	„	4.8	15	3.5	2.05	0.16	12.8	5	25
6-12	68	20	9	3	„	„	4.8	16	2.9	1.66	0.11	14.8	3	70
12-18	74	17	6	3	„	„	4.8	14	2.4	1.40	0.12	11.7	5	85
18-30	71	19	7	3	„	„	5.0	15	1.9	1.09	0.10	11.1	4	120
30-42	75	15	8	2	„	„	4.9	15	1.5	0.89	0.08	11.1	2	40
42-54	68	21	8	3	„	„	5.0	12	1.3	0.77	0.07	11.2	2	10

Except for one or two very steeply sloping hillsides, where the slope exceeds 20°, all the areas where this soil occurs under forest are considerable suitable for tree crops with high fertility requirements, and cacao, Manila hemp, fruit and oil palm are important crops which could be expected to grow well. The total area of Kuantan clay soil within the boundary of the Forest Reserve is estimated as 11,400 acres.

Pelawan Clay

The Pelawan clay is a very distinctive soil formed from basalt rocks over very gently sloping ground in the south-western corner of the area surveyed. The slope very seldom exceeds 5° and is normally only about 2 to 3°, while the soil is found only at low elevations and is best developed close to the boundary with the alluvial soils. At higher elevations and on steeper slopes there is a gradual transition to normal Kuantan series. The soil is susceptible to semi-permanent waterlogging in the lower-lying situations. In the better drained parts this soil may prove suitable for cacao, but the total area within the forest reserve is unlikely to exceed 250 acres.

The surface clay soil, which varies between two and 15 inches in thickness, is characterised by an unusual greenish-grey colour (nearest Munsell soil colour notation: dark greyish-brown, 2.5Y 4/2), and possesses a well developed granular to sub-angular blocky structure, permitting good root distribution. When dry the surface is covered by loose, rounded crumbs about 5 mm. in diameter. The gravelly clay subsoil

Typical profile of Kuantan Clay Series, showing normal colour and good root development

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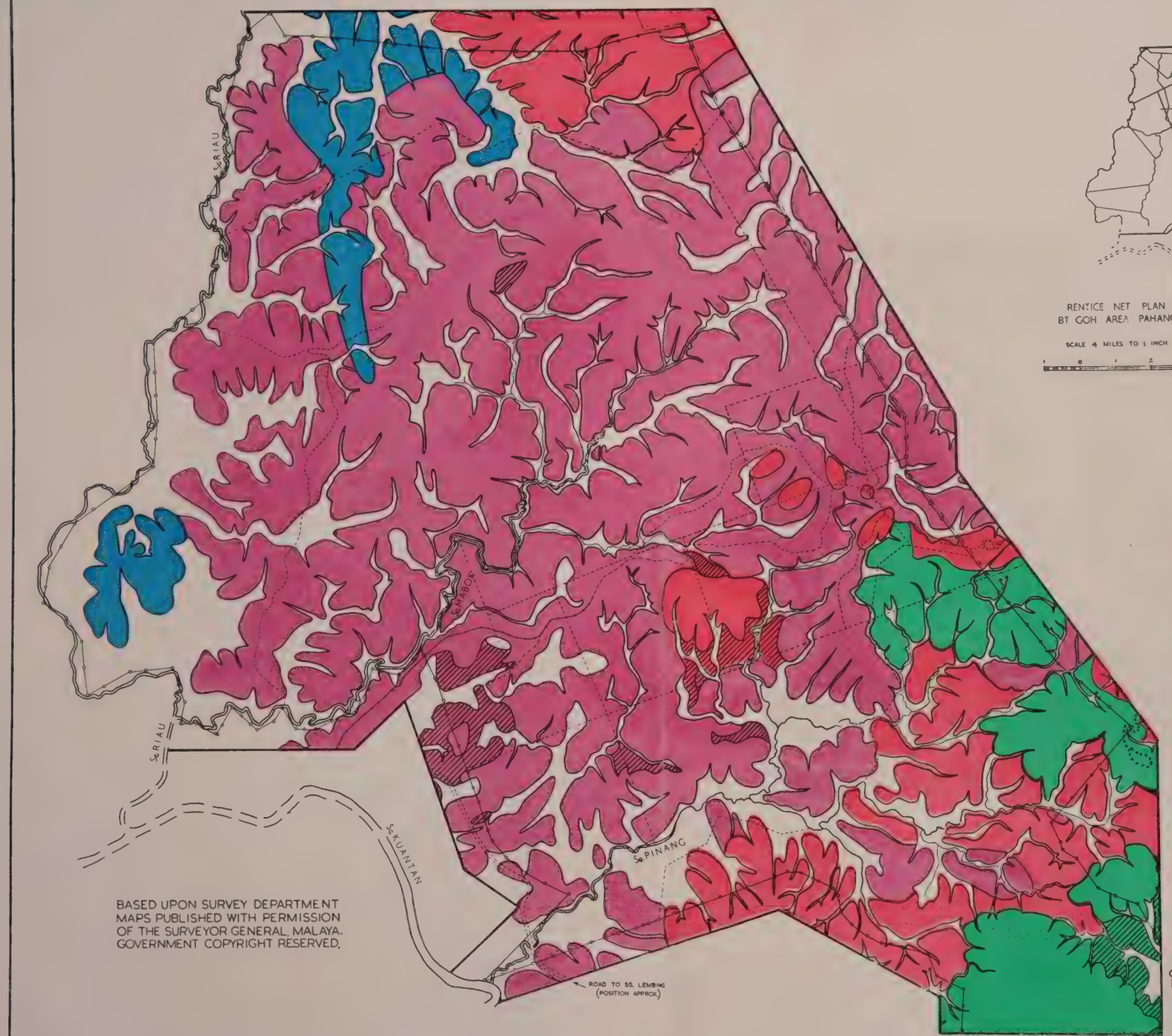
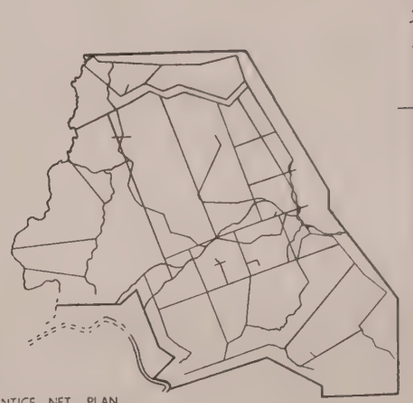
DETAILED RECONNAISSANCE SOIL MAP OF THE BUKIT GOH FOREST RESERVE PAHANG





RENTICE NET PLAN
BT GOH AREA PAHANG

SCALE 4 MILES TO 1 INCH

1 0 1 2 3

- KUANTAN CLAY
- PELAWAN CLAY LOAM & CLAY
- RENGAM SANDY CLAY LOAM
- RENGAM SANDY LOAM DEGRADED PHASE
- KAMPONG KUBOR CLAYEY COARSE SAND
- BUKIT TEMIANG COARSE SANDY LOAM
- SOILS DERIVED FROM SEDIMENTARY ROCKS
- UNDIFFERENTIATED ALLUVIAL SOILS

- FOREST RESERVE BOUNDARY
- FORMER LIGHT RAILWAY
- STATE BOUNDARY
- FOOTPATHS

SCALE 1 MILE TO 1 INCH OR 1:63,360

0 1 2

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DEC. 1957.

horizon is between 36 and 60 inches thick and has a weak medium sub-angular blocky structure, which permits good root development; the subsoil is underlain by a very moist, compact gravelly clay layer at about 38 to 62 inches, and this horizon is not penetrated by tree roots.

RENGAM SANDY CLAY LOAM.

This soil occurs most commonly in the south-eastern part of the area surveyed, but small patches have been located along the northern boundary and at one or two points within the main development of Kuantan series soil near the centre of the area. The profile has been described in detail in previous soil survey reports (3, 4) and it is only necessary to mention that the type developed in this district is rather coarser textured than that normally seen in other parts of the country. It occurs over moderately undulating land and would be quite suitable for rubber, and possibly more exacting crops, except in the extreme south-eastern corner where a very degraded phase of this series occurs under *lalang* over very gently rolling land; this area has been shown separately on the map. The area under jungle within that part of the Forest Reserve shown on the map amounts to 2,000 acres.

In addition to the Rengam series, a rather better soil occurs in one or two places along the boundary of the granite and basalt rocks, where it is almost certainly derived from a mixture of these two parent materials. Several variations occur, depending on the relative proportions of the parent rocks and the degree of mixing, but most typically the soil is a well structured sandy clay loam, or sandy loam, which is dark yellowish-brown (10YR 4/4) in colour. The soil covers only a very small area and its distribution is too limited to be shown on the map.

BUKIT TEMIANG COARSE SANDY LOAM.

The Bukit Temiang series has also been described previously (4) and it is unnecessary to give a further description here. It occurs over the steeper granite hills in the south-eastern corner of the area and is too steep and bouldery to be recommended for cultivation.

KAMPONG KUBOR CLAYEY COARSE SAND.

This colluvial soil occurs on almost level country at the foot of the small hill covered by Rengam sandy clay loam near the middle of the surveyed area. It has a two inch thick, weakly crumbed, brown 10YR 5/3) coarse sandy top soil, and a grey (5Y 5/1) to very dark grey (10YR 3/1) weakly crumbed and friable clayey coarse sand subsoil horizon with occasional yellowish-brown (10YR 5/6) mottlings at four inches and below. This poor soil is subject to seasonal flooding and cannot be recommended for tree crops which require high fertility.

SOILS DERIVED FROM SEDIMENTARY ROCKS.

These soils occur only along the western side and in the north-western corner of the Forest Reserve. They include two main types, one

being a friable, weakly crumbed, brownish-yellow (10YR 6/6) fine sandy clay loam which varies in depth from about 20 to 60 inches and is underlain by the parent material horizon which appears to consist of decayed quartzite. It occurs chiefly in the north-western corner of the reserve.

The second type, which is most common on the western side near the Sungei Riau, is a shallow, friable, weakly crumbed, brownish-yellow (10YR 6/6) fine sandy clay loam which is underlain by laterite at a depth of about 18 inches.

These soils are not considered to be suitable for crops requiring soils of high fertility and they were not examined in any detail.

UNDIFFERENTIATED ALLUVIAL SOILS.

There are four types of alluvial soils, each having a distinctive set of characteristic features by which it can be identified in the field. All of them are relatively poor soils which would be unsuitable for permanent tree crops, and, as they have not been examined in any detail, they have been grouped together for mapping purposes. Short descriptions of each type are given below.

The most freely draining of these soils is a pale brown (10YR 6/3) to light olive-brown (2.5Y 5/4) silty clay with prominent yellowish-brown (10YR 5/6) mottling which occurs on the western side of the area near the Sungei Riau; a second type is a stiff, pale-yellow (2.5Y 7/4) clay with yellowish-brown mottlings occurring in the smaller valleys, while muck soils underlain by grey to light grey (10YR 7/1) clay occur in some of the wider valleys on the western side of the Reserve.

The fourth type is a rather unusual bluish-grey clay or clay loam which is found only in the south-western part of the area, in the small alluvial valley south of the disused light railway track. This soil is characterised chiefly by its grey colour which shows a slight bluish tint, corresponding most nearly to the 10R 5/1 colour on the Munsell soil colour charts when dry and the 2.5Y 3/0 colour when wet. The soil appears to be subject to semi-permanent waterlogging and the surface is often characterised by a hogwallow type of micro-topography in which the jungle trees grow in clumps on small islands, while the intervening ground is bare of vegetation and covered by a thin layer of decomposing litter. The subsoil is a sticky, compact clay loam in which roots penetrate only to about 10 inches. Mottling is most strongly developed at depths of about 30 inches, while the water table which shows a wide fluctuation, seldom drops below four feet. The subsoil is sometimes bouldery, and round boulders of basalt may occur on the surface in places. The soil has been found only in this one area and it is unlikely to be of any agricultural importance.

Summary

The soil survey has shown that about 11,400 acres of land in the Bukit Goh Forest Reserve are occupied by a very deep, rich soil (Kuantan

series) which is considered to be quite suitable for crops requiring highly fertile soils, while an additional 2,250 acres are covered by two other soils (Rengam and Pelawan series), which, although not likely to be as good as the Kuantan series, could also be expected to prove suitable for similar crops. In view of the richness of these soils in comparison with most other Malayan hill-soils and taking into account the need for a greater diversification of crops, it is recommended that the land should be alienated specifically for high fertility crops other than rubber if the question of developing this area for agriculture should arise in the future.

Acknowledgements

The authors wish to express their thanks to Messrs A. L. Barcroft and G. L. Keeping, formerly State Agricultural Officers, Pahang, and P. Class, the present State Agricultural Officer, Pahang, for their interest and material assistance during the field work, and to Mr. F. C. Foenander, District Forest Officer, East Pahang, for permission to trespass at will over Forest Department property. Also to Mr. G. W. Arnott and the staff of the routine analysis section, Soil Science Division, for the analysis data which accompany this report.

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DISEASES OF PADI

BY

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Introduction

Several diseases of padi are present in Malaya, some occurring every year in most padi areas, while others are more sporadic and localised. The amount of damage caused by these diseases is difficult to assess. Some, such as the leaf spots, cause no obvious decrease in yield although in the aggregate their weakening effect on the plants must result in considerable overall loss. Others, such as stem rot, are often difficult to recognise and damage done may not be realised or may be blamed on other agencies. Perhaps because the damage done by these diseases can easily be overlooked and is not easy to evaluate, comparatively little attention has in the past been paid to them and no description of them has been published locally.

The object of this paper is to describe the diseases which occur in Malaya so that they may be recognised in the field by non-specialists. Where possible, control measures will also be suggested.

Key to the Common Diseases

The diseases can be conveniently grouped according to the part of the plant affected. Thus there are diseases which attack the leaf blade, others which are found on the stem and leaf sheath and some which affect the grain. In addition there is one disease which causes general stunting and leaf discoloration. These groups overlap to some extent (for example, blast (*Piricularia oryzae*) although mainly a leaf disease, is also found on stem and grain) but they form a useful practical basis for classification and identification.

As an aid in the recognition of the commoner diseases the following key may be found useful.

1. DISEASES CAUSING LEAF SPOTTING

Spots small, oval, reddish-brown, on seedlings or older plants - - - - - - - - - - - - - - BROWN SPOT

Spots large, spindle-shaped, grey with dark brown margins, on seedlings or older plants - - - - - BLAST.

Spots very small, rectangular, grey, only on older plants - - - - - - - - NARROW BROWN LEAF SPOT

Spots minute, black and shining, only on older plants - - - - - - - - - - - - - - - - - LEAF SMUT

Spots large, irregular, angular, greenish-grey or light grey, usually on older plants, occasionally on seedlings - - - - - - - - - - - - SHEATH BLIGHT.

2. STEM AND LEAF SHEATH DISEASES

Leaf sheaths with large greenish-grey or grey areas, outer leaf sheaths rotted. Sometimes small, roughly spherical white or brown bodies present near water level - - - - - - - - SHEATH BLIGHT.

Sheaths brown and rotten, whole tillers killed, small round black bodies often present inside hollow stem or in stem or sheath tissues - - - - STEM ROT.

Stem discoloured and broken just below head - - - -BLAST.

3. GRAIN DISEASES

Grain replaced by large, spherical, powdery, green or orange bodies - - - - - - - - - - FALSE SMUT.

Grain with oval, light-brown spots on glumes or grain completely blackened - - - - - - - BROWN SPOT.

Grain grey, only partly filled - - - - - - - - - - BLAST.

4. DISEASE CAUSING GENERAL STUNTING

Plant stunted, leaves discoloured dark red, purple, orange or yellow, leaves dying prematurely - - - - - - - - - - - - - - - PENYAKIT MERAH.

In addition to the diseases mentioned above there are also some minor diseases which may occasionally be encountered. These are briefly described in the last section.

Brown spot

(*Helminthosporium oryzae* Breda de Haan)

Brown spot is the commonest disease of padi in Malaya, being found to a greater or lesser extent every year in practically all padi areas. Except when very young seedlings are attacked, plants are not killed by this disease and the amount of damage done is difficult to assess, mostly consisting of a decrease in yield due to weakening of the plants.

Brown spot is mainly a disease of the leaves and occurs most commonly in the seed-bed. The leaves of affected seedlings bear numerous small oval spots, chocolate brown all over when small but developing a lighter brown or fawn centre when larger (Plate I). Attack at this stage is often severe and leads to dying back of the leaf tips and stunting of the seedlings. Badly affected nurseries can often be recognised from some distance by their brownish, scorched appearance compared with the normal green of healthy nurseries.

When the seedlings are transplanted the disease usually practically disappears but towards maturity leaf spots may again become common. These spots are similar to the seedling spots but are often considerably larger.

Although most obvious as a leaf disease, brown spot also infects

the grains. The result of such attack is the formation of small oval spots on the glumes or, in the case of more severe attack, complete blackening of the whole grain (Plate II). On seedlings grown from infected seed, brown diseased areas may develop on the stem or roots, resulting in the death of the seedlings soon after germination.

The disease is caused by the fungus *Helminthosporium oryzae*. It is invisible to the naked eye on spots on leaves or grains but can often be seen as a velvety mass covering blackened grains.

To reduce the severity of this disease the following measures can be adopted:

(1) MANURING OF THE NURSERY. The disease causes most damage in nurseries planted in poor soil. Nurseries on poor soli should therefore be manured to increase the resistance of the seedlings to brown spot. Excessive manuring must be avoided, as this increases the susceptibility of the seedlings to blast and leaf and sheath rot.

(2) USE OF A WET NURSERY. Dry nurseries are more liable to severe attack than wet and should therefore be avoided in areas where the disease is common.

(3) SEED DRESSING. Grain which is known to be heavily infected with brown spot should not be used for planting. Where such seed must be used, the disease can be controlled to some extent by dusting the seed with a mercurial seed dressing. Such substances are poisonous and to ensure safety the mixing must be done in a closed tin or drum. Only a very small quantity of the fungicide is required, three parts by weight being used for every 1000 parts by weight of padi. This treatment is only economically justifiable with heavily infected seed.

Blast

(*Piricularia oryzae* Cav.)

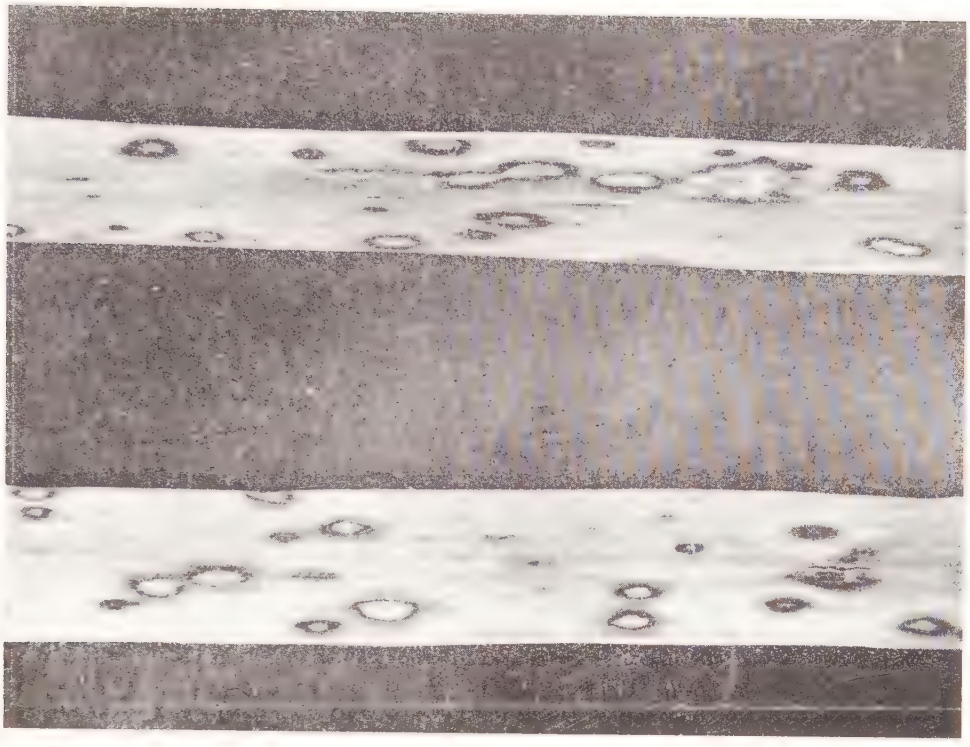
Blast was first observed in Malaya about 1945 and was thought to have been introduced on new varieties of padi brought in at that time from Formosa. It was found in 1946-47, however, that the disease was present in widely separated areas all over the territory and it is now considered that the disease has been present for many years.

Blast is common but only occasionally causes severe damage. When conditions are favourable to the disease, seedlings in the nursery may be killed in large numbers and from time to time serious loss of crop is also occasioned by heavy, though localised, attack just before harvest.

As in the case of brown spot, blast most commonly occurs as a seedling leaf spot. The spots are large, and are elongated and pointed at both ends, uniformly brown at first but later developing a light greenish-grey or grey centre (Plate III). The tips of affected leaves dry out and die and in severe attacks seedlings may be completely killed.

After transplanting the disease almost or completely disappears

PLATE I



Brown spot (*Helminthosporium oryzae*) on seedling leaves.

PLATE II

Brown spot (*Helminthosporium oryzae*) on grains. Affected grains are spotted or blackened.

PLATE III

Blast (*Piricularia oryzae*) on seedling leaves.

PLATE IV

Blast (*Piricularia oryzae*).
Broken neck phase of the disease.

but under conditions favourable to the disease it may recur about flowering time. Then leaf spots similar to but larger than those found on seedlings may occur but the most serious damage is caused by stem infections. If attack occurs early the flowering head may dry up and fail to emerge, or it may emerge but have empty ears. In either case when the stem is pulled out of the leaf sheaths, brown rotten areas in the stem can be seen. These indicate where the disease has developed. More easily recognisd is the broken neck phase of the disease, which occurs when attack is later. The stem is rotted just below the flowering head and breaks so that the whole head hangs down (Plate IV). The grains are as a result thin, light and only partly filled. The grains themselves are not commonly infected.

Blast is caused by the fungus *Piricularia oryzae*. Spores which spread the disease are produced on all diseased areas and can often be seen as a grey coating on the surface of leaf spots or on affected parts of stems.

Control of the disease depends on several factors:

(1) In the nursery blast is favoured by dry soil. Wet nurseries are not severely affected and therefore their use will prevent seedling attack.

(2) Excess nitrogenous manuring of the nursery also favours the disease and should be avoided.

(3) There is considerable difference between varieties in susceptibility to blast and where blast occurs immune or resistant varieties should, where possible, be used . Some of the commoner varieties have been tested and can be classified as follows (according to their reaction as seedlings) :

IMMUNE—Chanteh puteh, Padang Trengganu 22, Morak Sepilai Kechil, Anak Ikan Gresing, Anak Ikan China.

RESISTANT—Reyong 20, Acheh Puteh, Subang Intan 117, Radin Siak 34, Mayang Sa-Gumpal, Radin Che Mah, Serendah Puteh, Anak Naga, Jintan Puteh, Morak Sepilai, Anak Ikan Rendah, Radin Che Ali, Pe Bi Hun, Anak Ikan Sombong, Mayang Ebos 88, Radin Kuning, Seri Raja, Acheh.

SLIGHTLY SUSCEPTIBLE—Seraup Kechil 48, Radin China 17, Mayang Ebos 80.

SUSCEPTIBLE—Reyong 6, Radin Goi, Anak Ikan Tinggi, Kontor, Serendah Sungei Dua 25, Serendah, Anak Didek.

VERY SUSCEPTIBLE—Serendah Kuning, Chubai 18, Nachin 11, Taichu 65, Machang, Seraup Kechil 36, Mayang Sa-Batil, Milek Kuning, Siam 29.

(4) Spraying of the nursery with a fungicide is not recommended for general use but might be carried out where seedling attack occurs frequently and other control measures cannot be employed. Bordeaux mixture (1 lb. lime, 1 lb. copper sulphate, 10 gallons water) can be used, being applied with a knapsack sprayer at intervals of four to seven days.

Narrow brown leaf spot

(*Cercospora oryzae* Miyake)

Unlike blast and brown spot, this disease does not attack seedlings and heavy infections do not usually develop until flowering time. Particularly susceptible varieties such as Serendah Kuning may be attacked at an earlier stage, when leaves often die off prematurely from the tips and a set-back to growth occurs, but heavy infection usually develops so late as to cause little loss in yield. The disease is common and widespread.

The spots, which are caused by the fungus *Cercospora oryzae*, are very small and rectangular. At first uniformly brown in colour, they later develop a fawn or grey centre (Plate V). Although small, the spots may be very numerous. They occur on both leaf blade and leaf sheath.

It is not considered necessary to adopt control measures against this disease. Little is yet known about differences in varietal susceptibility but most local varieties appear to be fairly resistant. Serendah Kuning is an exception, frequently being seriously affected.

Leaf smut

(*Entyloma oryzae* H. and P. Syd.)

Leaf smut is not a disease of economic importance but is mentioned here because it is relatively common in many padi-growing areas. The disease occurs on the leaves of maturing plants and takes the form of minute, jet-black, slightly raised spots (Plate VI). Negligible damage is caused and control measures are not necessary.

Sheath blight

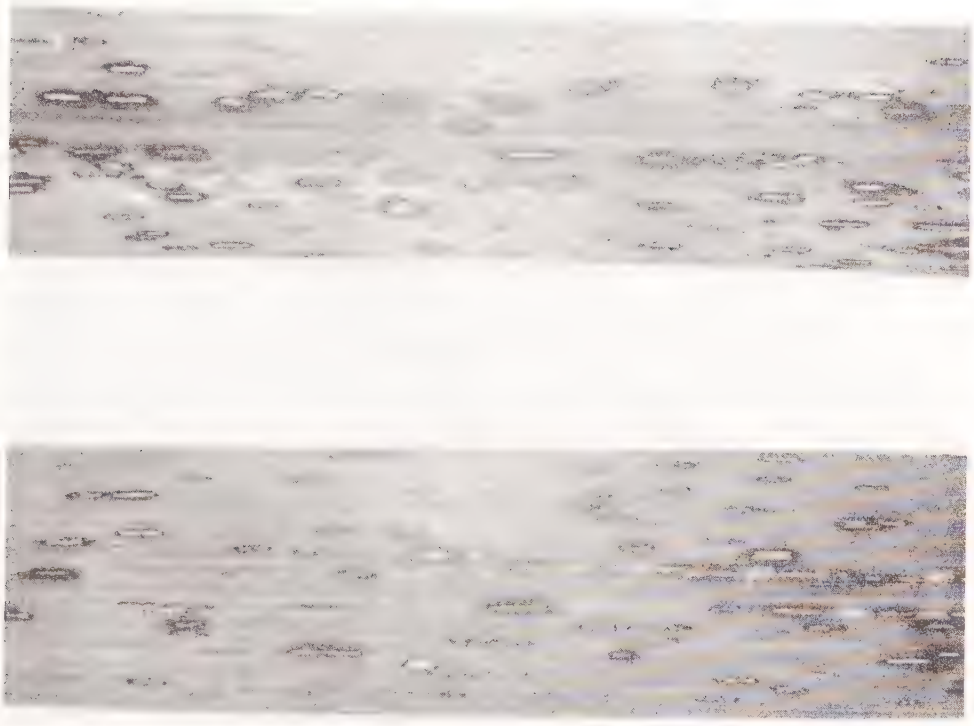
(*Rhizoctonia solani* Kuhn)

This disease, although widespread, occurs sporadically and usually appears only in small patches. In a few localities, however (e.g. in North Johore), it has caused considerable damage. Being very dependent on high humidity the disease usually develops in low lying areas, particularly where the water tends to be stagnant. In such places the disease recurs year after year and is difficult to eradicate.

The disease begins on the outer leaf sheaths, usually in plants which have passed the tillering stage. The causal fungus invades the tissues of the sheath, causing large irregular spots to appear, dull green at first but becoming light brown as they dry out. As the diseased area enlarges the whole leaf sheath is killed and the leaf blade dries up and withers. The fungus then penetrates to the inner leaf sheaths, killing off the leaves successively until in severe cases the whole tiller dies. Under favourable conditions the fungus may spread up the surface of the leaf sheath and attack the blade, where large irregular spots similar to those found on the sheath are formed (Plate VII).

Seedlings are also occasionally attacked by the fungus which causes sheath blight. Irregular spots similar to those on older plants first appear

PLATE V



Narrow brown leaf spot (*Cercospora oryzae*)

PLATE VI

Leaf smut (*Entyloma oryzae*)

PLATE VII

Sheath blight (*Rhizoctonia solani*)
Symptoms of attack on leaf blade.

PLATE VIII

Sheath blight (*Rhizoctonia solani*)
Sclerotia at the base of an affected plant.

on the leaves. Later the whole seedling is killed, the dead seedlings occurring in circular patches. This is particularly liable to occur when the seedlings are making lush growth in a sheltered, humid position.

The fungus causing those diseases is *Rhizoctonia solani*, also known as *Corticium solani*. *Rhizoctonia microsclerotia*, which may only be a variety of *R. solani*, also causes similar symptoms. The fungus appears as small rounded bodies with a roughish surface, white at first but later becoming brown, which are formed on the surface of dead leaf sheaths, usually near water level (Plate VIII). These sclerotia fall off the rotted sheath and help to spread the disease.

Control of sheath blight is difficult as the causal fungus can live in the soil during the off-season and so reappears in the same place the next season. High humidity and stagnant water favour the disease, so anything which can be done to reduce humidity and prevent stagnation should help to alleviate the trouble. Where attack is severe it would be advisable to destroy the worst affected plants, thus removing sclerotia and infected plant parts and so helping to prevent the spread of the disease.

Stem rot

(*Sclerotium oryzae* Catt.)

As in the case of sheath blight, stem rot occurs in scattered localities and does not affect large areas. It is, however, often difficult to recognise, particularly when attack is light, and may be more widespread than recorded outbreaks would suggest.

Attack begins on the outer leaf sheath, where black, rotten areas are formed. As infection spreads, the sheath dries up and the whole leaf dies. The fungus which causes the disease then penetrates inwards to the stem, killing successive leaves until the stem itself is attacked and killed. Affected plants are stunted, with many tillers completely dead, while most of the outer leaves of the remaining tillers are dead or dying. In severe cases few ears are produced and they bear only a little light grain. Typical of the disease is the production at a very late stage of young tillers at the base of an affected plant, these young green tillers being conspicuous among the dead and rotten old tillers.

If an affected stem is split open the causal fungus (*Sclerotium oryzae*) can be seen as a fluffy grey mass filling the hollow centre. The fungus also forms sclerotia—tiny black spherical bodies which occur in the hollow centre of the stem, between the leaf sheaths or embedded in the tissues of stem or leaf sheath.

Conrol of this disease, as with sheath blight, is difficult and depends, as the disease is soil-borne, on reducing the amout of infective material (diseased stems etc.) which returns to the soil after harvest. Ideally, infected plants and stubble should be burnt after harvest but it is rarely possible to do this thoroughly as they cannot be dried out. Instead, diseased plants should be removed and, after drying, burnt.

False smut

(*Ustilaginoidea virens* (Cooke) Tak.)

This is one of the more conspicuous padi diseases and has therefore been frequently reported. It nevertheless rarely causes much damage, although in some seasons it is common.

The disease takes the form of large round olive-green and orange bodies which take the place of the normal padi grains (Plate IX). They appear just as the padi is ripening, usually only a few grains in each panicle being affected. These bodies are the fructifications of the causal fungus (*Ustilaginoidea virens*), the surface being covered with dark green spores.

The life history and method of infection of this fungus are not known and no effective control measures have been found. As the appearance of the disease is sporadic and only a few grains on one or two heads are usually affected the damage done is not great.

Penyakit merah

The name *penyakit merah* (red disease) is used to describe a variety of conditions in padi, all of which are characterised by stunting of the whole plant and discoloration and dying back of the outer leaves. The disease is widespread, being found in most padi-growing areas, its prevalence and wide distribution being reflected in the number of different names by which it is known e.g. *penyakit rendah* (stunting disease) *penyakit kisar* (reversal of growth disease), *benah darah* (blood-coloured blight).

What might be called true *penyakit merah*, being the type of disease first known by this name, usually occurs in small, roughly circular patches, symptoms being severest in the centre of the patch and gradually lessening towards the periphery. Badly affected plants die. Less severely affected plants may remain alive but are stunted and produce no grain. When attack is light the plant may partially recover and produce some grain. Damage due to this type of disease is serious in small areas and symptoms tend to recur annually in exactly the same place.

Other types of disease, for which the name *penyakit merah* is used although not altogether appropriately, there being no reddening of the leaves, are of unpredictable occurrence. They often affect large acreages and although diseased plants are not killed, reduction in yield may be considerable.

Symptoms usually appear about two to three months after transplanting. In all cases growth is arrested and affected plants become stunted (Plate X). Invariably also the outer leaves dry out and die back from the tips. Before they die the leaves become discoloured. They may become dark purple, red, rusty brown, light orange or yellow, the colour varying with the locality and the variety of padi.

No insect or parasitic organism is regularly associated with *penyakit merah*. Eelworms (*Radopholus oryzae* v. Breda de Haan) can often be found in the roots of affected plants but are equally common in

PLATE IX

False smut (*Ustilaginoidea virens*).

PLATE X

Penyakit merah

Affected plants on right. Plants from a nearby unaffected area on left.

the roots of healthy plants. Among insects the black padi bug *Scotinophora coarctata* F. and the plant hoppers *Sogata furcifera* (Horv.) and *Nephotettix bipunctatus* F. can cause symptoms superficially similar to those of *penyakit merah*, while attack by the fungi *Rhizoctonia solani* and *Sclerotium oryzae* might also at first glance be mistaken for this disease. But as these parasites are not constantly associated with *penyakit merah* and the disease very often appears without the presence of any of them, they are evidently not the cause of the trouble.

The cause of the disease has not yet been determined but appears to be some unfavourable soil factor. Deficiency of some nutrient was first suspected but the results of experiments have not supported this theory. Applications of ammonium sulphate have in some cases reduced the severity of the symptoms but the effect has only been temporary. It is at present thought that in some cases at least, the disease may be caused by unfavourable water conditions but experimental proof of this has not yet been obtained.

As the cause of the disease is not known, no control measure can be recommended. There is, however, evidence of differences in susceptibility to *penyakit merah* between padi varieties and it should in future be possible to recommend resistant varieties for planting in affected areas.

Minor diseases

Black smut (*Neovossia horrida* (Tak.) Padwick and Azmat. Khan) affects the grains, in which small sooty black areas develop. The black material, consisting of the spores of the fungus, breaks through the glumes as the grains mature and in severe cases the major part of the grain is transformed into a powdery mass of spores. The symptoms are rather similar to those caused by severe infections of brown spot and the diseases can only be definitely distinguished by microscopic examination. Only a few grains in a panicle are affected and the disease is not common.

Spotting and discoloration of rice grains can also be caused by several other fungi, including *Trichoconis padwickii* Ganguly, *Curvularia offinis* Boedijn, *Pestalotiopsis disseminata* (Thum.) Steyaert and *Fusicladina* sp. The damage done to the grains by these fungi is negligible but the seedlings grown from infected seed may be attacked and killed or weakened by them. The use of clean seed ensures freedom from damage of this type.

On dry padi the mushroom-like fungus *Marasmius stenophyllus* Mont. has been recorded as attacking the leaf sheaths, penetrating inwards to the stem and ultimately killing the whole plant. The fungus appears to attack padi only rarely and is only capable of causing damage when the soil is poor.

Summary

The main diseases of padi occurring in Malaya are described and control measures suggested.

LEAF ANALYSIS IN RELATION TO YIELD AND QUALITY OF PINEAPPLES

BY

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Chemist.

Introduction

The pineapple industry in Hawaii is considered to be highly advanced and competes with those in other countries in spite of the high cost of labour. Tan Ah King (1957) in an unpublished report after a tour of the pineapple-growing areas of the world calculated that the wages of pineapple workers in Hawaii was $36 a day compared to $4.50 in Malaya. In spite of this marked difference in wages, the price of fruit at the door of the canneries was the same in the two countries. He further stated that the yield of pineapples per acre per annum in Malaya is 3.6 * tons compared to 13.0 tons in Hawaii. There are possibly many reasons for this low yield in Malaya and one of these is certainly connected with the application of fertilisers. The industry in Malaya has in the last few years become 'fertiliser conscious' and some plantations are applying fertilisers, but it is doubtful whether the right type of fertiliser is applied in the right amounts to give optimum yields of good quality fruit. It would not be surprising to find that in a few cases the application of fertilisers has proved to be detrimental and that in many instances the major portion of the fertilisers applied has not been utilised by the plants. After a good deal of work, the Hawaiian industry has come to rely on leaf analysis as a sound basis for recommending the type and quantity of fertiliser to be applied to pineapple plants. It was therefore decided to investigate whether the method could be adapted to local conditions, with modifications if necessary.

Theoretical Considerations

According to Cooke (1) the technique followed in Hawaii is to take the base of the youngest fully grown leaf for analysis and on the basis of the results of this analysis, fertiliser recommendations are made. This is usually done in Hawaii during the period of two to five months after planting and while the plants are establishing themselves. Fertilisers are applied from nine to twelve months after planting or earlier if the results of the analysis indicate that the mineral deficiency is serious. The planting cycle in Hawaii is between four and five years, unlike that in Malaya, where it is rather indefinite but very much longer. The normal practice in Malaya seems to be to cut out the plants which have fruited and use them as a mulch for the ratoon crops. Thus the large majority of the plants would have developed from suckers and would be of indefinite age. In order to overcome this difficulty, it was decided to take samples from fully grown plants which had neither a flower nor a fruit. It

* Estimate for large plantations is about 5.6 tons at present.

should then be possible to correct any deficiencies found in these plants by the immediate application of fertiliser before the critical flowering and fruiting stages.

In Hawaii the base of the youngest fully grown leaf is analysed, as this contains the smallest amount of chlorophyll nitrogen and is considered the best indicator of nitrogen deficiency. Incidentally, in Hawaii pineapples are grown on laterite soils and nitrogen is considered to be the most important nutrient. In Malaya pineapples are grown mainly on peat soils, which have adequate reserves of nitrogen that are made available on the decomposition of the peat but which are very deficient in potash and possibly other nutrients. It is not definitely known which nutrient is the most important in Malaya, so it was decided to analyse the three portions, base, middle and tip, of the youngest fully grown leaf separately and also, if possible, to analyse an older leaf in the same way.

Preliminary Leaf Sampling and Analysis

In order to find out how many leaves were required for a sample and what part of the leaf was most suitable for analysis, samples were taken from the Federal Experiment Station, Jalan Kebun. Three samples of 15 leaves each were taken at random from each plot; four plots were sampled, out of which two were fertilised with complete NPK fertiliser, one was a discard plot which had probably been fertilised and one was an unfertilised plot. The attempt to take an older leaf other than that suggested by the Hawaiian workers was found to be difficult as the leaf was hard to identify and could not be detached from the plant by the usual method of a sharp pull. The samples were put into polythene bags, taken to the laboratory, cleaned with a piece of cloth and cut into three approximately equal portions. The tip, middle and base portions of the leaves were then separately chopped into small pieces and dried in a current of air at 60 to 70°C. for about 24 hours. The dried samples were ground in a Christie and Norris laboratory mill and nitrogen was determined on a portion by the micro-kjeldahl method. Part of the dried and ground sample was ashed in a muffle furnace at 450 to 550°C. and potassium, phosphorus, magnesium and calcium were determined in the ash by the usual methods employed in these laboratories. The results obtained are given in Table I.

Examination of the figures in Table I reveals that there are marked differences in the percentages of magnesium and potassium between the unfertilised and the fertilised Sarawak plots. The differences are shown most clearly when the tip is analysed. The sampling error in a few cases is rather large and could possibly be reduced by taking about 30 leaves to constitute a sample, although the more important plot error could not be evaluated in this preliminary trial. Besides, the material obtained from 15 leaves would not leave much to spare in case trace elements were also to be estimated. It was therefore tentatively decided to take about the terminal one-third of the leaf from about thirty plants to constitute a sample.

Table I

Results of Analyses of Pineapple Leaf Samples from the Federal Experiment Station, Jalan Kebun

Samples taken on 9th March, 1956.

Plot	Sample	TIP						MIDDLE						BASE					
		% on dry basis		% on ash				% on dry basis		% on ash				% on dry basis		% on ash			
		N	Ash	P	K	Ca	Mg	N	Ash	P	K	Ca	Mg	N	Ash	P	K	Ca	Mg
A. Sarawak — Unfertilised	1	1.27	5.76	1.82	7.92	10.63	26.23	1.22	5.10	2.79	11.73	8.74	20.61	1.10	5.84	3.61	26.40	5.99	13.28
	2	1.12	5.85	1.98	13.10	10.60	23.93	1.16	5.27	2.34	24.44	7.22	15.59	1.03	6.15	3.61	30.25	5.81	12.64
	3	1.23	5.69	1.93	9.10	9.78	26.01	1.23	5.05	2.50	21.95	7.72	17.49	1.21	5.88	2.90	27.88	5.35	14.49
	Mean	1.21	5.77	1.91	10.04	10.34	25.39	1.20	5.14	2.54	21.37	7.89	17.90	1.11	5.96	3.37	28.18	5.72	13.47
B. Sarawak — Fertilised with NPK	4	0.88	6.57	1.76	27.82	7.20	13.93	0.84	5.60	2.03	34.33	4.54	9.39	0.72	6.10	2.75	35.36	4.27	8.82
	5	0.96	5.94	1.41	26.80	7.15	14.04	0.85	5.86	1.74	33.51	5.63	9.98	0.91	6.34	2.39	36.41	4.47	8.77
	6	0.92	5.96	1.65	30.41	5.88	11.26	0.79	5.51	2.06	35.76	4.70	8.91	0.79	6.71	2.58	35.21	4.19	8.06
	Mean	0.92	6.16	1.61	28.34	6.74	13.08	0.83	5.66	1.94	34.53	4.96	9.43	0.81	6.38	2.57	35.66	4.31	8.55
C. Singapore Spanish — Discarded Plot	7	1.06	5.00	4.26	32.96	4.33	8.69	0.96	5.44	3.79	36.02	2.87	6.38	0.87	5.90	4.19	35.81	2.66	6.63
	8	1.14	4.93	3.50	32.86	4.01	8.82	0.97	5.00	3.29	35.63	2.85	6.75	0.82	6.00	3.91	37.19	2.42	6.35
	9	0.99	5.10	3.24	34.15	4.34	7.95	0.83	5.23	3.29	36.72	2.60	6.04	0.79	6.67	2.70	36.51	2.69	6.43
	Mean	1.06	5.01	3.67	33.32	4.23	8.49	0.92	5.22	3.46	36.12	2.77	6.39	0.83	6.19	3.60	36.50	2.59	6.47
D. Singapore Spanish — Fertilised with NPK	10	1.08	4.48	2.07	31.99	5.33	10.54	0.92	4.48	2.41	36.17	3.70	7.71	0.92	6.17	2.67	36.57	3.21	6.99
	11	1.22	5.28	1.69	31.97	5.19	9.81	0.91	5.20	2.17	36.75	3.89	6.97	1.01	6.94	2.52	38.38	3.37	7.08
	12	1.17	4.98	1.94	31.94	5.28	10.35	0.95	4.95	2.27	36.45	3.75	7.83	0.92	6.73	2.62	39.81	3.27	6.72
	Mean	1.16	4.91	1.90	31.97	5.27	10.23	0.93	4.88	2.28	36.46	3.78	7.51	0.95	6.61	2.60	38.25	3.28	6.93
S.E. between samples 8 D.F.		±.0676	±.276	±.463	±1.684	±.456	±1.055	±.0474	±.239	±.213	±3.43	±.495	±1.328	±.0738	±.338	±.456	±1.352	±.199	±.529

Fertiliser Experiment Sel. 98

On the basis of this preliminary leaf analysis, it was decided to take leaf samples from Experiment Sel. 98. This experiment had been laid down by the Agronomy Branch of the Department of Agriculture in November, 1952, at the Federal Experiment Station, Jalan Kebun. Its aim was to find the effect of the addition of potash on the yield and quality of pineapples. Pineapple plants of the varieties Singapore Spanish and Sarawak were planted in plots. Each plot was 54 ft. long and 36 ft. wide (1,944 sq. ft.). The distance between plants was 6 x 2 ft., giving 3,630 plants per acre. The plots of Singapore Spanish and Sarawak pines were randomised and muriate of potash was added equivalent to 0, 50, 100, 150 and 200 lb. K_2O per acre per year. Each treatment had six replicates. Muriate of potash was applied in March and September each year. Nitrogen and phosphate were first applied in November, 1954, and the same nutrients were subsequently applied along with the potash treatment at the rate of 55 lb. of Christmas Island rock phosphate (equivalent to 20 lb. P_2O_5) and 95 lb. ammonium sulphate (equivalent to 20 lb. N) per acre per application. In August, 1955, the old plants were cut and left as a mulch. Two suckers were left in the place of one old plant, thus increasing the plant population to 7,260 plants per acre. Yield records for the various treatments were kept by the Agronomy Branch.

FRUIT ANALYSIS.

Samples of pineapple fruits harvested from this experiment during the years 1954, 1955 and 1956 were analysed for total solids, sugar, titratable acidity and *p*H. The more recent results obtained from these analyses are given in Table II.

Table II

Pineapple Fruit Analysis (Edible Portion)

Treatment (lb. K_2O per acre per annum)	Singapore Spanish (Harvested in Dec., 1955)			Sarawak (Harvested in Dec., 1955)		
	Total Sugar %	Titratable Acidity %	*p*H of Juice	Total Sugar %	Titratable Acidity %	*p*H of Juice
200	10.64	0.72	3.86	13.31	0.73	3.73
150	10.25	0.81	3.79	13.89	0.76	3.64
100	9.94	0.74	3.86	12.72	0.76	3.71
50	9.67	0.70	3.88	13.41	0.75	3.73
0	9.43	0.55	4.05	13.61	0.78	3.86
	Singapore Spanish (Harvested in June, 1956)					
200	10.34	0.72	3.82			
150	10.24	0.72	3.91			
100	9.82	0.63	3.97			
50	9.71	0.63	3.97			
0	9.13	0.33	4.51			

It is clear from the table that in the Singapore Spanish there was a steady increase in the total sugar in the edible portion of the fruit with increasing application of potash. There was also a sudden change in the titratable acidity and in *p*H with the first 50 lb. of potash; thereafter the change was small. The quality of the fruits, as judged by higher sugar and acid content and by low *p*H, was improved by the addition of potash. The quality of the Singapore Spanish fruits from the control plots harvested in June, 1956, had deteriorated to a very marked extent. The Sarawak variety, on the other hand, did not show any appreciable change with the addition of potash.

YIELD AND SIZE OF FRUIT.

The yield and size of fruit for the period from the 20th August, 1954, to the 30th July, 1956, are given in Table III.

Table III

Yield and Size of Fruit

Treatment (lb. K_2O per acre per annum)	Singapore Spanish		Sarawak	
	Yield per acre (lb.)	Average fruit weight (lb.)	Yield per acre (lb.)	Average fruit weight (lb.)
0	17130	2.65	15600	6.31
50	23080	3.02	18000	6.84
100	25430	3.05	18600	6.79
150	25890	3.20	16200	6.84
200	24710	3.10	17000	6.50
S.E. of means, each based on 20 D.F.	±857.9	±0.492	±1198	±.2394

The highest yield of fruit with the largest size for the Singapore Spanish variety was obtained when 150 lb. of potash was applied. There was in fact a steady increase in yield and size as more and more potash was applied, reaching a maximum at 150 lb. potash and then the size as well as the total yield showed a tendency to fall. With the Sarawak variety the maximum yield was obtained when 100 lb. of potash was applied, but the largest fruit size, which is not statistically significant, was obtained for the applications of between 50 and 150 lb. potash. The important fact is that in both the Singapore Spanish and Sarawak varieties the yield of fruit increased with the application of potash, reached a maximum and then tended to fall with further application.

LEAF ANALYSIS OF EXPERIMENT SEL. 98.

The leaves from plots of Singapore Spanish and Sarawak receiving 0, 100 and 200 lb. potash per acre per annum were sampled. Leaf tips from 30 to 40 plants from each plot constituted a sample. Incidentally, this represented more than half the plants that were at the right stage for sampling and in some cases nearly all the plants at the right stage were sampled. The samples were analysed in the usual way for nitrogen, phosphorus, potassium, calcium and magnesium. Since each treatment had been replicated six times, only the mean values are given in Table IV.

Table IV

Analyses of Leaf Tip Samples Taken in May, 1956
Experiment Sel. 98

(Means of six replicates)

Treatment (lb. K_2O per acre per annum)	Percentage		Percentage				
	On dry matter		On leaf ash				
	N	Ash	P	K	K/P ratio	Ca	Mg
Singapore Spanish							
200	1.50	5.26	2.27	35.3	15.55	5.19	8.9
100	1.44	4.81	2.57	29.1	11.32	6.95	13.3
0	1.60	4.32	4.37	10.8	2.47	9.77	24.7
S.E. of mean 15 D.F.	±.088	±.064	±.133	±.855		±.283	±.634
Sarawak							
200	1.04	6.47	1.51	30.19	19.99	6.21	12.87
100	0.99	5.97	1.76	27.25	15.48	7.70	15.28
0	1.31	4.96	2.40	13.41	5.59	9.68	24.07
S.E. of mean 15 D.F.	±.039	±.212	±.367	±.751		±.215	±.623

The results of leaf analysis show that in both varieties the percentage of potash in the leaf more than doubled for the application of 100 lb. potash; thereafter the increase with further application was much less. With the application of potash the concentration of all the other elements had a tendency to fall, except possibly the concentration of nitrogen in the case of the Singapore Spanish variety. Magnesium and, to a smaller extent, calcium largely replaced potassium in the leaf when potassium was in short supply.

The potassium-phosphorus (K/P) ratio in the leaves, which is discussed later would be about 14 : 1 (from Table IV) if the Singapore Spanish variety had been fertilised with about 150 to 175 lb. K_2O and

the Sarawak variety had been fertilised with about 75 lb. K_2O per acre per year. The concentration of nitrogen in the leaves for any treatment of the Sarawak variety was lower than that of the Singapore Spanish, while the percentage phosphorus in the leaves of the Sarawak was also correspondingly lower.

Relation of Leaf Analysis, Yield and Quality

It has been observed in Hawaii that the value of the K/P ratio in the leaves is very important for yield and quality. Cooke (1) in his report on the pineapple industry in Hawaii, states as follows: "Considerable emphasis was laid on the importance of maintaining the same potash-phosphorus ratio in the soil as in the healthy leaves (viz. 12 : 1) since it is said that if too much phosphorus is added, the nitrogen intake is upset and the result is a reduction in the yield of fruit". The ratio 12 : 1 is given for the bases of young leaves and using the mean values for P and K of the fertilised plots in Table I, this works out to approximately 14 : 1 when the tips of young leaves are considered. The figure 14 is only an approximation and requires further confirmation. Besides, the Hawaiian figure may not be the best under Malayan conditions. In spite of these drawbacks, the following tables are worth consideration.

Table V

K/P Ratio in Leaves, Yield and Quality
Singapore Spanish Variety

Treatment (lb. K_2O per acre per annum)	Yield in lb.	Quality		K/P Ratio
		Total Sugar %	Titratable Acidity %	
200	24710	10.34	0.72	15.6
150	25890	10.24	0.72	—
100	25430	9.82	0.63	11.3
50	23080	9.71	0.63	—
0	17130	9.13	0.33	2.48

It appears that the highest yield of good quality fruit was obtained at a K/P ratio between 11 and 15, at approximately just above 150 lb. of K_2O per acre. Addition of more K_2O to 200 lb. and increasing the K/P ratio to 15.6 has tended to reduce yields. There has also been no appreciable change in fruit quality.

Table VI

K/P Ratio in Leaves, Yield and Quality
Sarawak Variety

Treatment (lb. K_2O per acre per annum)	Yield in lb.	Quality		K/P Ratio
		Total Sugar %	Titratable Acidity %	
200	17000	13.31	0.73	20.0
150	16200	13.89	0.76	—
100	18600	12.72	0.76	15.5
50	18000	13.41	0.75	—
0	15600	13.61	0.78	5.6

Here again, as in the case of the Singapore Spanish, the maximum yield was obtained at a K/P ratio of 15.5, that is, near 14. The yield drops as the ratio diverges from the figure 14. The quality of fruit has been unaffected and, as will be explained, this may be due to lack of nitrogen, which could have been caused by the unavailability of nitrogen or phosphorus or both.

Wallace (2), in a review on the nutrition of fruit crops, points out that with fruits from temperate countries the amounts of available nitrogen and potash affect their quality. Usually when nitrogen levels are high the fruits tend to be large, green, coarse-textured and of acid flavour. When the nitrogen levels are low, the fruits are often highly coloured, sweet and of high dessert quality. Potassium-deficient fruits are notably small, woody and sub-acid and sometimes may be sweet to the taste. The quality of pineapple fruits seems to be affected more or less in the same way as fruit from the temperate countries. When the levels of the two elements nitrogen and potassium are at their optima in the plant, fairly large, good quality fruits are obtained. The availability of phosphorus effects the uptake of nitrogen by the plant, so that phosphorus has an indirect effect on the quality of the fruit.

It appears from the results of this experiment and those of the Hawaiian workers that with adequate supply of other nutrients, the yield and quality of pineapple fruit depends largely on the quantity of potash and phosphorus available to the plant. It is not the absolute amount of these two elements but the ratio which is of importance. It is therefore not surprising that the Hawaiian pineapple industry takes special care to maintain the value of the K/P ratio of the leaf at the definite figure of 12 by means of fertiliser addition. The experiment further suggests that the methods and the deductions arrived at by Hawaiian workers could, with slight modifications, be made use of by the pineapple industry in this country. Fertiliser applications need not be on an arbitrary basis but based upon sound scientific principles. The results also indicate that mere application of any fertiliser to pineapples may not result in increased yield or in better quality fruit. It is only when the right fertilisers are applied at their optimum amounts that high yields of good quality fruit are obtained.

For the Singapore Spanish variety a tentative recommendation for maximum yield of good quality fruit would be that on analysis of the youngest fully grown leaf tips of mature plants which have neither fruit nor flower, the results should give approximately the following percentages:

nitrogen (N)	1.2 ± 0.2
phosphorus (P)	2.2 ± 0.3
potassium (K)	32.0 ± 4.0

The K/P ratio should be as near as possible to 14.

Summary

Yield of pineapples per acre in Malaya is low and this may be partly due to lack of fertiliser application or the application of fertiliser on a rather arbitrary basis.

A method of leaf sampling based on the Hawaiian method used for fertiliser recommendations has been investigated.

In the particular experiment described, Experiment Sel. 98, the application of potash has influenced the quality of fruit in the Singapore Spanish variety but not in the Sarawak variety. In both varieties the yield increased and then tended to fall with increasing amounts of potash.

The results of leaf analysis can be related to yield and quality of fruit.

Leaf analysis provides a good basis on which to recommend fertilisers for pineapples.

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GRAPEFRUIT CULTIVATION AT GAJAH MATI AGRICULTURAL STATION, KEDAH

BY

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Introduction

Grapefruit has been grown successfully at the Gajah Mati Agricultural Station, Kedah, for a number of years. One block of trees of local origin has done particularly well. In this article, aspects of cultivation and varietal differences are discussed. Also, details are given of yields for the 1956-57 season, together with costs of management of a block of a local variety.

History

Very little written information is available about the establishment of citrus at Gajah Mati. The first trees of grapefruit, GF5 from Perlis, were planted in 1941 but were neglected during the Japanese occupation. However, growth of this variety was promising enough to warrant further expansion. In 1947 a 0.71 acre block of GF5 was established using budded and marcotted plants. These have been carefully maintained and have developed into first-class trees. Betwen the years 1950 and 1953 other varieties of grapefruit, including imported varieties, have been planted, but growth has been irregular and the trees have produced fruit with a wide range in size and proportion of skin to fruit.

Gajah Mati Agricultural Station

LOCATION

Gajah Mati Agricultural Station is situated at an altitude of 50 ft. between the North Kedah Plain and the first series of hills inland. It lies on longitude 100°33′ E. and latitude 6°10′ N. Many consider this latitude to be the minimum for the growth of grapefruit at this altitude.

CLIMATE

The climate is seasonal, with two peaks of rainfall and two dry periods. The main wet period extends from August to November and is followed by the long dry perod from December to March (See Fig. 1). To indicate the variation of rainfall the figures for 1944 (a 'dry' year) and 1956 (a 'wet' year) have been added. The intensity of the dry period has a definite bearing on flowering and the following fruit crop. Too long a dry season will cause a premature drop of young fruit; too short a season, poor flowering.

The soils of this area are derived from shales, schists and phyllites and resemble soils of the Malacca series. Hill padi cultivation has been practised for years in this inland area, resulting in erosion of the top soil and poor fertility. A typical soil profile, on which grapefruit is grown, is shown in Table I.

Table I

Typical Soil Profile, Gajah Mati Agricultural Station

Depth	Soil
0 to 6 in.	Fine sand (grey).
6 to 14 in.	Fine sandy loam (grey-yellow).
14 to 24 in.	Fine clayey loam (greyish yellow with dark red mottles).
Below 24 in.	Fine clayey loam with medium-sized lateritic concretions, texture becomes heavier with depth.

Cultivation of Grapefruit

The cultivation of grapefruit has been confined to the deeper soil areas on the station, i.e. where the depth of topsoil above the laterite is 20 to 24 in.

Planting

Before planting the trees, holes 2 ft. square and 2 ft. deep were dug and refilled with topsoil and farm-yard manure. Recently, additions of 1 lb. of Sterameal planting-hole mixture per hole have been made in an attempt to overcome the inherent lack of organic matter and nutrients. Every effort is made to establish the trees during the April to May short wet period, in order to gain full advantage of the longer wet period from August to November. Mulching of the trees with padi straw or other grasses and periodic watering are carried out during the dry period.

Cover Crops

Two types of cover are used between the trees. The first is a grass cover consisting of savannah grass (*Axonopus compressus*) which is mowed regularly. The second is *Stylosanthes gracilis* and/or *S. sundaica*. The *S. sundaica* has been established only recently. It is too early to say which is more beneficial, but present indications point to a leguminous cover crop for young trees, giving away to a grass cover as the trees grow older (6 to 7 years).

Fertilisers

Macro-elements

A prepared mixture of fertilisers, consisting of 40 parts by weight of sulphate of ammonia (21 per cent N), 40 parts by weight of Christmas Island rock phosphate (36 per cent P_2O_5), 12 parts by weight of muriate of potash (60 per cent K_2O) and 8 parts by weight of kieserite (26 per

cent MgO) is used as the main fertiliser. Extra applications of sulphate of ammonia are applied to make up the nitrogen requirement. The kieserite has tended to overcome symptoms of magnesium deficiency, which have been marked in the past. Consideration is given to the age of the tree when determining the quantities of fertiliser to be applied. Annual dressings of 12 lb. of the mixture and 5 lb. of sulphate of ammonia are given to the older trees (12 years and over). Before the application of the fertiliser, clean weeding and holing with a fork are done. This holing operation, which results in deeper fertiliser placement, tends to encourage deeper root penetration and may help to offset the effects of the long dry period.

Micro-elements

Typical symptoms of copper and zinc deficiency have been observed. To overcome these, 5 lb. zinc sulphate is mixed in and applied with the normal Bordeaux mixture (5 : 5 : 100). Zinc is present as an impurity in Christmas Island rock phosphate, but assimilation through the leaf is much quicker than through the roots.

PESTS

A number of pests attack the crop, especially during the fruiting season. The fruit-boring caterpillar (*Citripestis sagittiferella* Moore) has been the most troublesome and is responsible for the majority of fruit losses. The citrus leaf miner caterpillar (*Phyllocnistis citrella* Staint), the weevil (*Hypomeces squamosus*), the night-flying bettle (*Apogonia* sp.) and scale insects attack the foliage.

DISEASES

Canker (*Xanthomonas citri*) attacks the leaves and fruit. If the fruit is immature some malformation may occur, while with the mature fruits only the skin becomes blemished. Collar rot (*Phytophthora* sp.) has effected some trees in the past, necessitating bridge-grafting.

VARIETIES

Eight varieties have been established at the station; six of these are recorded in the clonal register of the Department of Agriculture. These are GF1 (Marsh's Seedless), GF3, GF4, GF5, GF6 (McCarty) and GF7 (Duncan). The other two, Gillet Late and Triumph, have been tseted but the results up to date have been disappointing. Table II contains a summary of the fruit characteristics of the eight varieties. Plates 1 and 2 indicate the variation in fruit size and proportion of skin to fruit in the eight varieties.

Block 12—Grapefruit GF5

BACKGROUND

The original stock of GF5 was brought to Gajah Mati Agricultural Station from the garden of the British Adviser, Perlis, in 1940. It is believed that these trees were imported from South Thailand many years

Table II

Grapefruit Varieties Grown at Gajah Mati Agricultural Station

Variety	*Stock*	*Seeds*	*Juice Content*	*Acidity*	*Texture*	*Taste*	*Skin*
GF1 (MARSH SEEDLESS)	*C. macroptera*	Few (large)	Juicy	Slight	Fine	Insipid	Medium-to-thick
GF3	Unknown	Few (large)	Dry	Slight	Coarse	Insipid	Thick
GF4 *							
GF5	*C. macroptera*, mandarin and pomelo marcots	Few (medium)	Juicy	Slight	Fine	Excellent	Thin
GF6 McCARTY)	*C. macroptera*	Many (small)	Juicy	Acid	Fine	Insipid	Thin
GF7 (DUNCAN)	*C. macroptera*	Few (large)	Juicy	Slight	Fine-to-medium	Fair	Thin
(GILLET LATE)	*C. macroptera*	Few (large)	Juicy	Acid	Fine-to-medium	Insipid	Medium
(TRIUMPH)	*C. macroptera*	Many (medium)	Juicy	Slight	Fine-to-medium	Insipid	Medium

* Not yet in bearing.

before. From this original stock, material was budded onto stocks of *Citrus macroptera*, mandarin (*Citrus suhuiensis*), and pomelo (*Citrus grandis*) and was established in Block 12 between the years 1947 and 1949. A row of marcots was planted also. Table III shows the layout and types of trees planted in the block.

Table III

Layout of Block 12 at Gajah Mati Agricultural Station

Row No.	*Rootstock*	*Date Planted*	*No. of Trees*
1	*Citrus macroptera*	20.12.49	8
2	Mandarin	15.12.47	8
3	Pomelo	3.12.57	8
4	Mandarin	3.12.47	8
5	Pomelo	3.12.47	8
6	Mandarin	14.11.47	8
7	Pomelo	14.11.47	8
8	Marcots	14.11.47	8
	Total		64

N.B. Three trees, one in each of rows 2, 3 and 7, were replanted in 1954 and 1955.

DEVELOPMENT

The trees planted in 1947 were maintained carefully from the time of planting. Pruning has given them a well balanced, open-centre appearance. The trees budded on *C. macroptera* stock and planted in 1949 have a more upright appearance, probably due to different pruning. The northern ends of rows 7 and 8 are low-lying and subjected to standing water during the long wet period each year. Collar Rot (*Phytophthora* sp.), has developed on five trees, necessitating bridge-grafting. This operation has been quite successful and does not appear to have effected yields. A grass cover crop (*Axonopus compressus*) was established in this block and is mowed regularly. During unusually dry periods watering from a hand-cart is necessary.

The fruiting season commences in August and is ended abruptly with the onset of dry weather in January when all fruit remaining on the trees ripen quickly and, if not harvested, fall to the ground. It is possible that the fruiting season could be extended into February if some form of irrigation were introduced before the end of December. Fruit-borer damage increases in the dry weather, necessitating daily hand-picking of infected fruit and regular sprayings of Dieldrex 15 in water (concentration 1:150) in order to reduce fruit loss to a minimum.

Individual tree yields are available only for the seasons 1952-53 and 1956-57. These are given in Tables IV and V, respectively. Since 1952 the trees in Row 1 have come into bearing, so that a proportionate

comparison is not possible over the whole block. However, if we consider the trees in bearing in these two seasons in the 1952-53 season, 1,436 fruits were harvested from 33 trees, an average of 43 per tree, and in the 1956-57 season 5,964 fruits were harvested from 61 trees, an average yield of 98. This corresponds to the fifth and ninth years after planting, respectively. Plate 5 shows part of the crop which was harvested in 1956.

Table IV

Individual Yield Record of Trees of Grapefruit GF5
from August, 1952, to January, 1953
(Numbers of fruit)

Row	1	2	3	4	5	6	7	8	Plant Totals
Plant No. 1	—	86	23	62	19	30	—	158	378
„ „ 2	—	109	30	3	—	27	—	—	169
„ „ 3	—	22	26	—	13	48	—	6	115
„ „ 4	—	—	40	40	30	27	23	—	160
„ „ 5	—	—	—	—	8	—	8	73	89
„ „ 6	—	—	5	—	5	—	—	7	17
„ „ 7	—	22	85	28	—	—	—	214	349
„ „ 8	—	—	7	—	—	—	36	116	159
Row Totals	—	239	216	133	75	132	67	574	1,436

Number of trees	64
Average number of fruit per tree	22.44
Number of trees in bearing	33
Average number of fruit per tree in bearing	43.5

Table V

Individual Yield Record of Trees of Grapefruit GF5
from August, 1956, to January, 1957

Row	1	2	3	4	5	6	7	8	Plant Totals
Plant No. 1	82	46	102	102	17	16	53	95	513
„ „ 2	201	173	96	81	33	—	133	31	748
„ „ 3	214	117	78	53	50	178	143	24	857
„ „ 4	56	37	173	194	402	175	145	130	1,312
„ „ 5	33	68	75	67	342	142	—	27	754
„ „ 6	73	59	135	281	321	226	78	8	1,181
„ „ 7	41	—	19	15	35	20	24	26	180
„ „ 8	98	33	20	117	53	22	17	59	419
Row Totals	798	533	698	910	1,253	779	593	400	5,964

Number of trees	64
Average number of fruit per tree	93
Number of trees in bearing	61
Average number of fruit per tree in bearing	98

Management Costs and Income in the 1956-57 Season

EXPENDITURE.* The estimated expenditure on Block 12 is as follows:—

(a)	Mowing with a Ferguson-drawn Hayter (4 rounds)	$ 3.72
(b)	Clean weeding and forking around trees	111.60
(c)	Cost of fertilisers at $1 per tree for 61 trees and 25 cents per tree for 3 trees	61.75
(d)	Cost of labour for application of fertilisers	12.55
(e)	Pruning	50.40
(f)	Harvesting of fruit	41.00
(g)	Cost of spraying material	13.26
(h)	Application of sprays	21.73
	Total	$ 316.01

REVENUE. Of the 5,964† fruits harvested during the fruiting season, the following were sold:—

(a)	4,565 at 20 cents each	$ 913.00
(b)	451 at 30 cents each	135.30
	Total	$1,048.30

ESTIMATED NET PROFIT PER RELONG (0.71 ACRES), EXCLUDING CAPITAL CHARGES .... $ 732.29

Discussion

It is obvious that grapefruit of good eating quality and appearance can be grown successfully on selected soils in Kedah. Difficulties are many and call for a reasonably high standard of husbandry to obtain maximum yields. Some aspects of maintenance and cultivation remain to be investigated. It is felt that some form of irrigation, probably based on a spray system, would be helpful in extending the present fruiting season, which is curtailed by the onset of the dry season. The question of an ideal cover crop has not been answered, although the present use of a grass cover cut regularly appears to be highly beneficial. On the extension side, the problems of persuading the local smallholders to establish grapefruit orchards and of their subsequent maintenance have not been tackled; extension may well prove difficult in view of the bias against eating the fruit amongst the large majority of the local population.

Summary

The cultivation and maintenance of grapefruit in Kedah has been discussed. Present results and observations suggest that a high quality fruit can be produced by the local variety.

* Unfortunately, the information available on costs is insufficient to estimate the cost of establishment.

† These include fruits damaged by insects.

Acknowledgements

The Agricultural Assistant in Charge, Gajah Mati Agricultural Station, has been very helpful in tabulating expenditure costs and yield figures. Also, I wish to thank the State Agricultural Officer, Kedah and Perlis, Mr. A. L. Barcroft, for his helpful and constructive criticism.

Editor's Summary

Of eight grapefruit clones in cultivation at the Gajah Mati Agricultural Station, north Kedah, the Perlis variety, GF5, has proved to be the most promising.

A block of 56 trees of the Perlis grapefruit was planted at the end of 1947 at a spacing of 20 x 20 ft., equivalent to 77 trees per *relong* or 109 trees per acre.

An extra 8 trees were planted two years afterwards, at the end of 1949.

Fruiting season lasts from August to early January.

Yields of fruit are available for only two seasons. These are summarised below:—

Yield of Grapefruif (fruit per acre)

Stock	*5th year*	*7th year*	*9th year*
C. suhuiensis	2,287	—	10,082
pomelo	1,624	—	11,543
marcots	7,814	—	5,445
C. macroptera	—	10,863	—

Yield variation between trees in such that no definite conclusion can be made as to which type of stock is best for commercial cultivation. However, trees on their own roots gave the heaviest yields in the 5th year while trees on pomelo or local mandarin stocks yielded best in the 9th year. Trees on *C. macropetra* stock have also yielded well in their 7th year.

Choice of stock did not affect quality to any marked degree.

The best fruit can be retailed at 40 cents each in Kuala Lumpur. This represents a gross return, ex-orchard, of about 20 cents each. Hence, a yield of 10,000 fruit per acre obtainable in the 7th year represents a gross return of $2,000 per acre.

FIG. 1

Rainfall at the Gajah Mati Agricultural Station, Kedah.

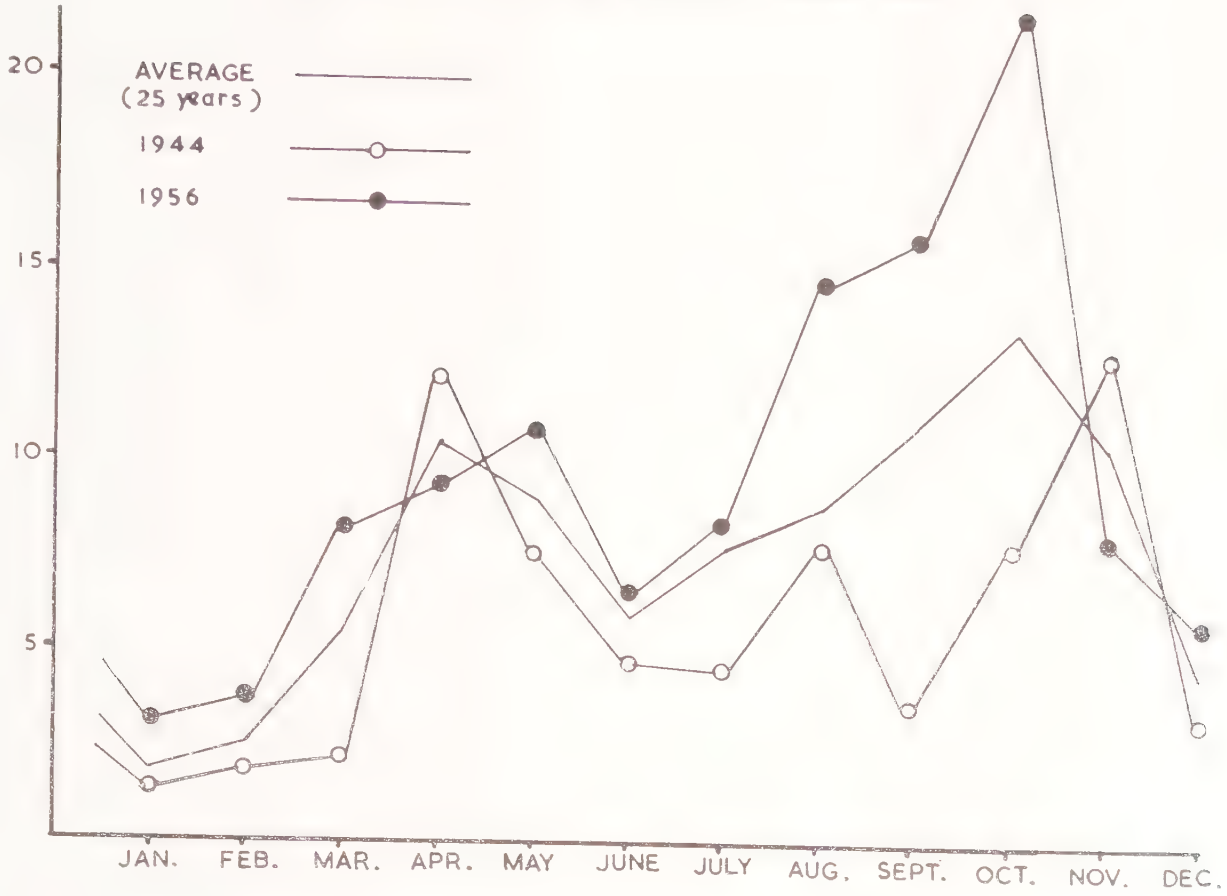
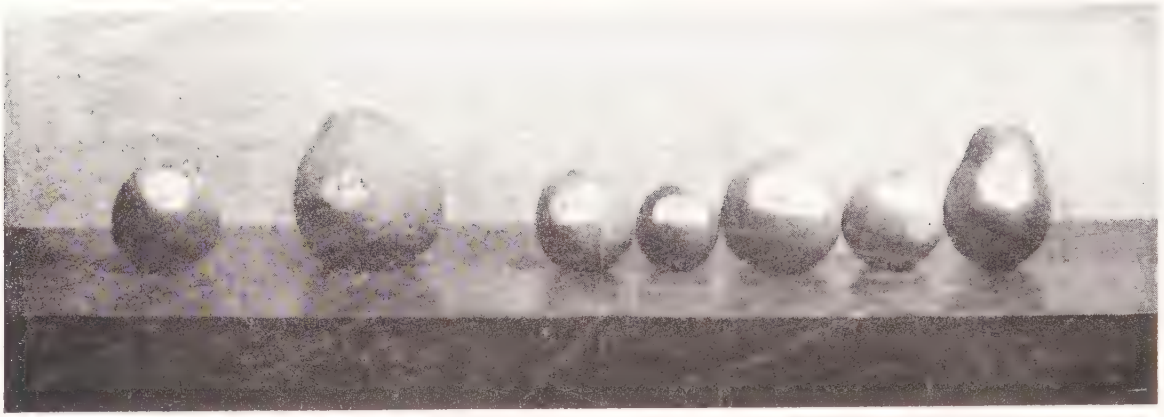
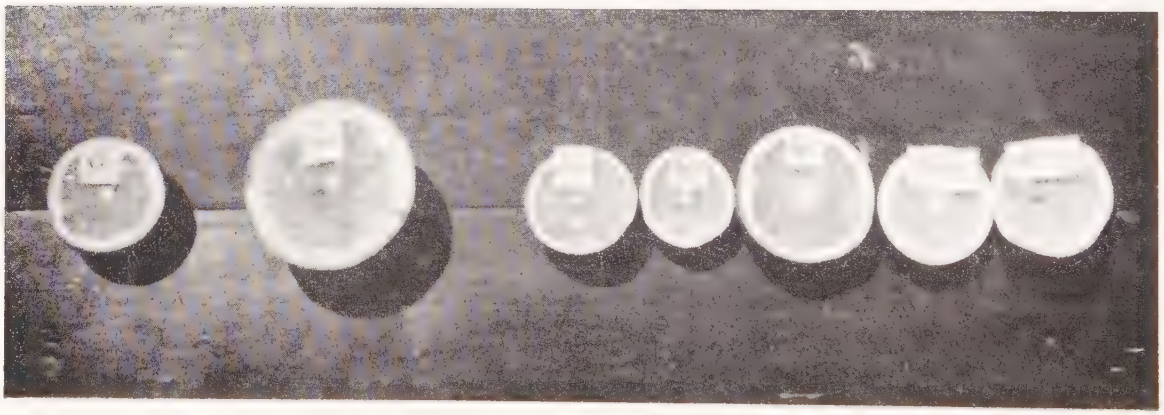


PLATE I



Variation in Fruit Size.
From left to right: GF1 (Marsh Seedless), GF3, GF5, GF6 (McCarty) GF7 (Duncan), Triumph, Gillet Late.

PLATE II

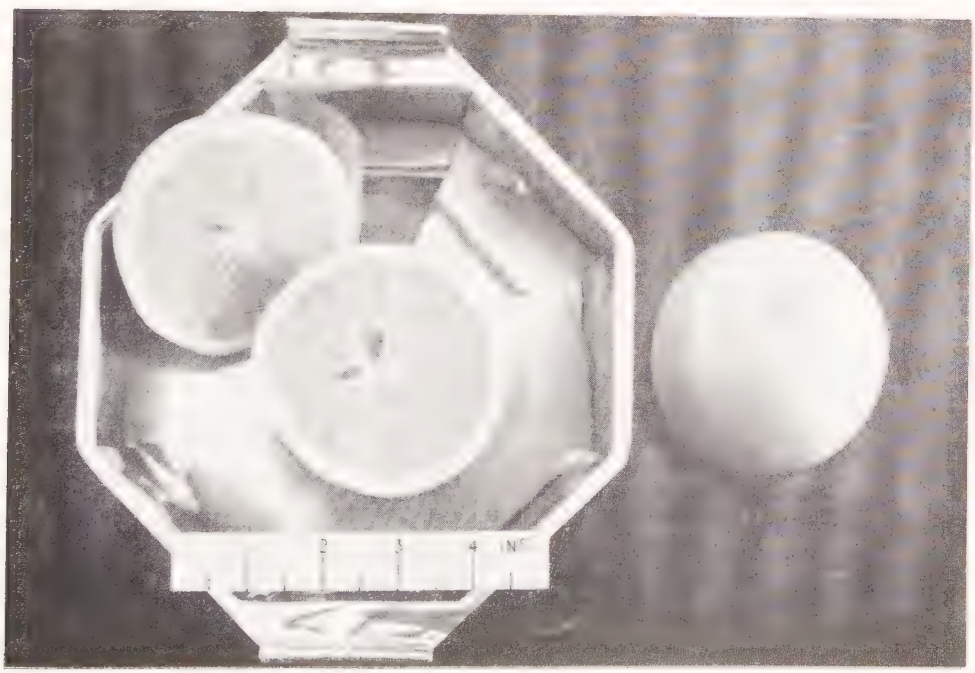


Variation in Ratio of Skin to Fruit. From left to right as in Plate I.

PLATE III

Perlis Grapefruit packed 70 fruit to the case.

PLATE IV



The Perlis Grapefruit (G.F.5) in section.

PLATE V

One of the well laden trees in Block 12 (1956 to 1957 Crop).

A NOTE ON JUTE CULTIVATION IN MALAYA

BY

E. F. ALIEN,

Formerly Acting Deputy Director of Agriculture.

Introduction

Jute or guni fibre is a soft brown fibre obtained from the stems of two species of *Corchorus*, namely *C. capsularis* and *C. olitorius*. Established plants of the farmer species are resistant to flooding and can be grown on padi land in the off-season but *C. olitorius* is grown on higher land.

Varieties

Indian varieties do not thrive in Malaya; they branch prematurely and do not grow tall. Only *C. capsularis* variety *Segama* from North Borneo can be recommended.

Soils

Segama jute has been grown successfully only on rich muck soils and organic clays. It will grow on well-manured inland loams but is then susceptible to disease.

Cultivation

Seed is sown at the rate of 10 lb. per acre. If it is broadcast, care should be taken to get an even spread; the seedlings are later thinned out to 6 in. apart. Better results can be obtained by sowing in drills 2½ ft. apart and thinning the seedlings to 4 in. apart. Periodic weeding is required in the early stages of growth, after which the crop itself will shade out most weeds.

Pests and Diseases

On dry land Segama jute is often killed suddenly by "Collar Canker" caused by *Colletotrichum capsici*. This has not been found important on wet soils but it is recommended that seed should be treated with a mercurial dressing before sowing. These dressings are poisonous but experimental batches of seed can be treated free by the Department of Agriculture.

Mites cause a leaf curl at the time of flowering. Attack is always too late to affect fibre production but may seriously affect the yield of seed. These mites can be controlled by spraying with wettable sulphur or with proprietory acaricides, details of which can be supplied by the Senior Entomologist at the Department of Agriculture, Kuala Lumpur.

Harvesting of Stems for Fibre

Segama jute will grow to a height of 6 to 8 ft. before flowering commences, this being usually about four months after sowing. The stems should be cut at ground level, tied into bundles and stacked ("stooked") in the open for a few days until the leaves have fallen off. They are then ready for retting.

Retting

Retting consists of soaking the stems in water until the bark can readily be peeled off from the woody core, the latter being discarded. Retting is best carried out in slowly-moving water; stagnant or fast-moving water is less satisfactory.

After 10 to 15 days the bark should be stripped off and further cleaned by scraping on a blunt knife to remove the outer corky layer and the inner soft green tissues.

The fibre is thoroughly washed in clean water and then sun-dried for four to five days, after which it is sometimes brushed to remove remnants of non-fibrous tissues.

Yields

Crops grown by smallholders in the Sekinchang area of West Selangor in 1955 yielded 760 lb. of fibre per acre, but yields of 1,000 lb. per acre or more can be obtained if top dressings of 1 to 3 cwt. of sulphate of ammonia per acre are applied. This fibre is purchased at 20 cents per lb. by the State Agricultural Officer, Selangor, with funds provided by the Rural and Industrial Development Authority.

Discussion

Chinese farmers of Sekinchang who have grown jute in their own country have all been impressed by the vigour of growth and yield of this Segama jute which, they say, is superior to that of varieties used in China. Furthermore they consider that it is at least as easy to grow as maize, which is the standard off-season crop for this large padi area. However, jute retting is a laborious process whereas maize cobs are easily harvested and marketed. Gross returns from the two crops at 1957 prices are as follows:—

Crop	Yield per acre	Unit Price	Gross Return per acre
Maize	5,000 cobs	2½ ct. per cob	$125
Segama jute	750 to 1,000 lb.	20 ct. per lb.	$150 to $200

It will be seen that the future prospects for Segama jute are sufficiently attractive to merit further work on the crop. The latest prices (July, 1957) for first quality jute have been in the region of £105 to £111 per ton c.i.f. Even if hand-retted Malayan jute realizes

only £80 per ton c.i.f. this should be sufficient to maintain a local price of 20 ct. per lb. Naturally price varies with quality, which is very largely dependent on the type of water used for retting and on the efficiency of stripping. A sample of Segama jute grown at the Sungei Burong Agricultural Station, Selangor, was sent to the Colonial Products Advisory Bureau in 1953 and this was submitted to the British Jute Trade Research Association, where it was examined by physical tests and also reported on by an assessor who was a spinner and an expert on jute. The Association's report is summarised in Tables I and II and their remarks are quoted below:—

> "Although the fibre is slightly coarse compared with Bengal jutes, the sample represents a good effort to grow a reasonable jute. This coarseness, however, may possibly be due to the fact that the crop was not harvested until the first seed pods became ripe. The best quality fibre is generally considered to be obtained shortly after flowering has taken place. It is suggested that further trials should be directed towards improving the quality of the fibre as suggested in the spinner's report and by harvesting just after flowering."

Table I

Physical Properties of Fibre

Tensile Strength (kg./sq.mm.)[1]	106.2
Area of cross-section of fibres broken (sq.cm. x 10^{-5})	1.3
Average area of cross section of fibres in sample (sq.cm. x 10^{-5})	2.5

[1]Average of 30 results; corrected to a time of break of 10 sec.

Table II

Spinners' Assessment.

Length: 7 feet.

Colours: Predominantly dirty grey.

Strength: Good to very good.

Spinning Quality: Mixed; some strands have reasonably good quality while others lack it.

Faults: Roots are too heavy and should have been more closely trimmed. Occasional runners in the body greatly detract from the appearance; these should have been removed.

Note: The assessor is shown the fibre without previous knowledge of laboratory results or name or origin of the fibre.

Since 1954 some two tons of dry fibre have been purchased from small farmers in the Sekinchang area and the best samples have been superior to that sent to London. It is evident, therefore, that reasonable quality fibre can be grown in Malaya but that extension of the crop is dependent on both economic factors and the replacement of retting and hand stripping by mechanical decortication.

Summary

Segama jute, a variety of *Corchorus capsularis,* which was introduced by the Department from North Borneo, can be grown successfully as an off-season crop in parts of the Tanjong Karang Irrigation Area on the Selangor coast.

Yields of 760 to 1,000 lb. per acre of dried fibre can be obtained.

Quality of Malayan-grown jute is reasonable but there is room for improvement in timing the harvest and in subsequent retting and stripping.

Retting and hand-stripping are unpopular with farmers and it will be necessary to replace these operations by mechanical decortication if cultivation of this crop is to be extended.

PLATE I

Segama jute grown by farmers in the Tanjong Karang Irrigation Area, Selangor.

PLATE II

The fibre length of Segama jute varies from 7 to 8 ft.

PLATE III

Segama jute baled for export.

MICROFERMENTATION OF COCOA FOR SELECTION WORK

BY

F. N. G. CONATY, *Senior Chemist*,

AND

M. SMITH, *Chemist*.

Introduction

A cocoa pod contains about forty beans, each surrounded by pulp which is firmly attached to the testa. The cotyledons are dark purple, varying to pale purple or ivory colour in some cocoas. They are bitter tasting and have no chocolate flavour even after roasting. During fermentation the cotyledons separate and become less bitter and their purple colour bleaches; the pulp decomposes off the testae and the beans become plump. During this stage of the process the most important change is the development in the bean of chocolate flavour "precursors" which give the characteristic chocolate aroma when the fermented and dried beans are roasted. The chocolate-brown colour develops later.

In commercial operations, the beans are taken from the pods and placed in non-metal containers (metal corrodes), varying in size from baskets lined with banana leaves and holding about 50 lb. to wooden vats taking perhaps 3000 lb. of raw beans. Alcoholic and then acetic fermentation of the pulp by wild yeasts and bacteria follows and a temperature of 50°C may be reached in the fermenting mass. The cocoa is stirred every two or three days or is turned into another container to mix thoroughly. This mixing gives uniform fermentation, controls mould growth, aerates the mass and allows carbon dioxide to escape. Liquid from the pulp is allowed to drain off from the bottom of the container.

The time required for fermentation varies very much with the type of cocoa, a day or two for the white and up to nine days for the dark purple beans. Normally the changes in acidity and fermentation follow a fairly regular pattern and can be used as a guide, but experienced operators can judge the time required by inspection.

Cocoa may be processed by other methods which remove the pulp, develop the brown colour and give what appears to be a good cocoa. Such cocoa is sometimes said to have little or no flavour but may be used in the preparation of some food products requiring a low bacterial count.

As there was no established cocoa industry in Malaya it became necessary to investigate the varieties which under local conditions would give the best yield and quality of cocoa, as these are important factors in the selection of plants for propagation purposes. Quality and yield are estimated after the raw beans have been fermented and dried. In order to carry out these investigations, small lots of raw beans had to

be processed. The problem in such methods is to prevent undue loss of heat and moisture.

A review of the literature shows that such work may be classified under the headings of small scale and microfermentation. The former method is used for batches up to say, 100 lb. and is useful where laboratory facilities are not available. The micro method is used in laboratory experiments, working usually with one podful of beans or less, and is also suitable for a study of the changes taking place during fermentation.

Experimental Fermentation

Small-Scale Fermentation

One method used is to place a muslin bag containing a sample of cocoa beans inside a large batch of other cocoa with which it is allowed to ferment. During the process the sample can be removed and the beans mixed and aerated while the large batch is being turned. This method is commonly used for fermenting small batches of cocoa when commercial lots are undergoing fermentation. Wadsworth and Howat (15) say that it is unlikely that the test cocoa absorbs any flavour from the surrounding mass, which merely provides the suitable conditions for fermentation to take place, but the West African Cocoa Research Institue (13) say that the pulp may affect the cocoa flavour.

Another method used is the MacDonald Solar Fermentary. This is basically a double-walled, insulated wooden box with a glass lid fixed in a sloping position to allow heating by the sun and containing several smaller boxes, each holding 30 to 60 lb. of wet cocoa. A modification of this is described by Knapp (9) and another by De Witt (4) was in use at River Estate, Trinidad.

Howat, Powell and Wood (8) designed a water-jacketed, stainless steel tank heated by kerosene burners and made to take 30 to 60 lb. wet cocoa. These workers also designed large tanks on the same principle for experiments with batches of up to 5000 lb. in which they installed thermostatic control and compressed air to aerate the mass.

Microfermentation

Microfermentation has been defined as the fermentation of less than 3 lb. of cocoa beans (12), and even single beans have been processed by laboratory methods.

A compensated microfermentary is described by De Witt (2, 3) in which insulation is provided by using a thermos jar packed inside an insulated wooden box. A 600 ml. beaker containing the beans fits inside the flask and allowance is made for drainage by placing an inverted watch glass supported on a glass rod inside the bottom of the beaker. The beans are covered with moist cotton wool and then with dry cotton wool and the beaker is closed with a cork carrying a thermometer. A low powered electric coil provides enough heat to compensate for the small loss which still takes place, even with the heavy insulation which makes the apparatus bulky in relation to its capacity.

MacLean and Wickens (10, 11) fermented one or two podfuls of beans in a 10 ml. Buchner funnel placed in a thermostatically controlled oven. This oven method is used by the West African Cocoa Research Institute for selection work. Wadsworth and Howat (15) incubated cocoa beans in an air oven and also in a water bath. Incubation in water baths may be preferred because not only are ovens expensive but they tend to dry the cocoa; water is more easily contained and kept at the required temperatures than air.

Some Effects of Fermentation and Drying

True fermentation takes place in the pulp which surrounds the beans. This is at first anaerobic, converting the pulp sugars to alcohol, and is followed by the aerobic fermentation of alcohol to acetic acid. Wadsworth and Howat (15) used the yeast *Hansenula anomala* and the acetic bacillus *B. Orleanense* for the correct sequence. A mixed inoculation is necessary. De Witt (2) exposed fresh beans to the air for an hour before placing in the fermentary to infect them with wild organisms, and found that this provided the required mixed inoculation. This method may introduce undesirable organisms but these are normally controlled by the conditions of fermentation.

According to Wadsworth and Howat (14, 15) oxygen is necessary throughout fermentation and drying and the carbon dioxide produced both by fermentation and by the living bean must be removed or no chocolate precursors develop. Others (7) say that the access of oxygen to the cotyledons during fermentation prevents precursor formation. In some methods of microfermentation, provision is made for absorption of carbon dioxide in caustic potash solution, and in commercial fermentaries the gas is dispersed by turning over the fermenting mass. As fermentation proceeds a rise in temperature takes place and according to Brown (1) the seed is killed when this reaches 44°C. During the first days of fermentation the preliminary stages of germination take place and the enzyme systems in the beans become active. When the beans die the testae and cell walls become permeable, so that cell contents can diffuse throughout the cotyledons, while water and possibly other substances from the pulp are absorbed into the beans. Reaction between substances allowed to mix in this way gives the chocolate precursors, whose exact composition is unknown. The beans are probably killed by the combined effects of heat and acid or alcohol.

Working with pure culture fermentation, Wadsworth and Howat (15) found that the *p*H of the pulp fell from 4.0 to 2.5 while at the same time only a slight change from 5.5 to 5.0 took place in the cotyledon. The West African Cocoa Research Institute (13), working with batches of 20 to 250 lb. of cocoa, reported an increase in moisture content of the bean from 34 to 39.5 per cent. These are the observations from which Wadsworth and Howat concluded that it was unlikely that esters passed into the beans from the pulp, affecting the flavour, while the West African

Cocoa Research Institute reached the opposite conclusion, that as the additional moisture must have been absorbed from the pulp it was probable that the pulp had some effect on the flavour.

The first stage of fermentation up to the time the bean is killed normally takes about three days. Wadsworth and Howat (15) say that it is necessary for the beans to be alive at the start and that they require a few days at a relatively low temperature to allow pre-germination changes to take place as this is necessary to the development of chocolate precursors.

According to De Witt (3) browning of the cotyledons takes place during the second part of the fermentation, i.e. from the third to sixth day, and continues until drying is nearly complete, when oxidase activity is inhibited by loss of moisture. Browning is an enzymic oxidation, dependent on atmospheric oxygen, and can take place whenever the interior of a bean is exposed to air. Forsyth and Rombouts (6, 7) say, on the other hand, that if oxygen reaches the cotyledons during fermentation, the bean substances which should be converted anaerobically to chocolate precursors are oxidised instead, so that no precursors can be formed. Aerobic oxidation during drying gives the characteristic brown colour and allows the formation of less astringent tannin complexes. Brown (1) states that it is probable that the tannins exert some degree of tanning action on the bean proteins so that the cured nibs are more brittle and more easily crushed to a fine degree for a complete release of fat.

Many workers agree that the period of drying should allow for the continuation and completion of the oxidation changes. The normal method of sun-drying takes care of this because drying is allowed to take place slowly during the first few days and afterwards the beans are exposed to the sun for longer periods daily to reduce moisture to 6 to 7 per cent, which is dry enough to arrest mould development. Drying over a period of six days has been adequate to give good quality cocoa.

Artificial dryers are often used, in which conditions may be controlled over a fairly wide range to allow for slow rate of drying at the early stage to be followed by rapid drying at higher temperatures.

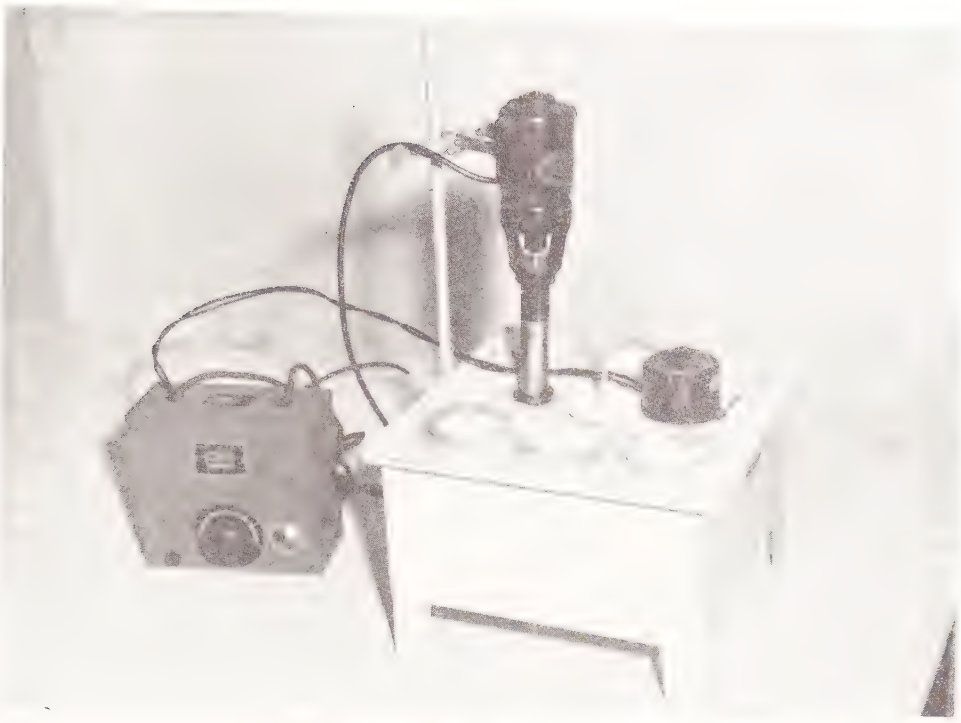
Method of Fermentation and Chocolate Preparation for Routine Investigations

Apparatus

It was necessary to work on single podfuls of cocoa, so a micro-method of fermentation had to be used. In the early experiments a De Witt compensated microfermentary was set up but it was found difficult to provide efficient insulation. It was decided that a new unit should be made using water as the incubating medium because its temperature is more easily controlled and it can be contained in cheaper and simpler apparatus.

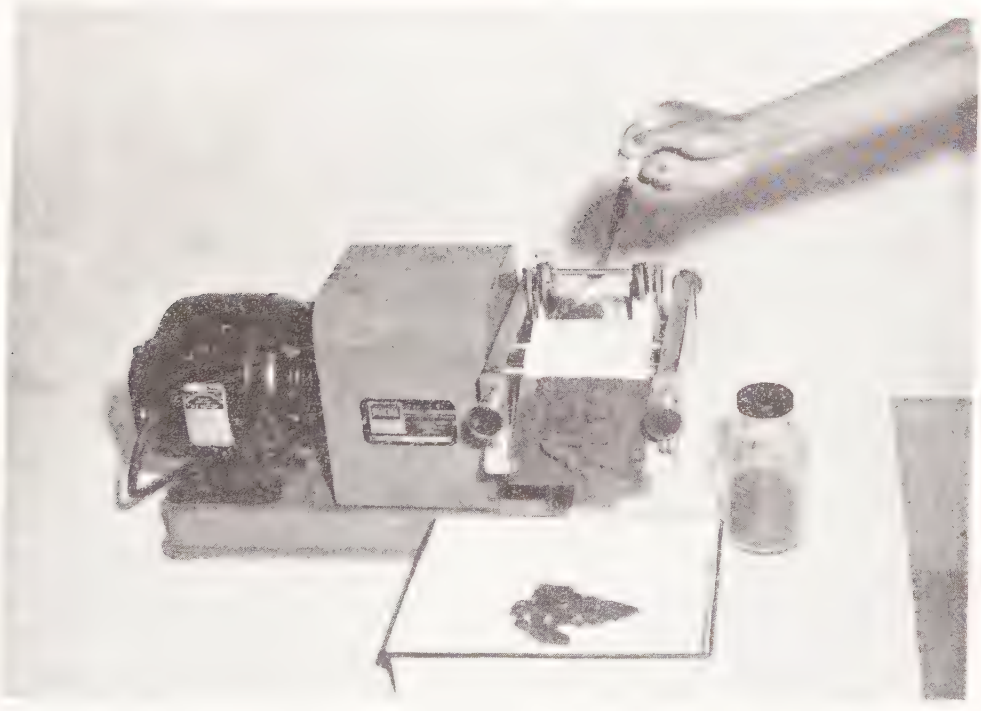
A multiple microfermentary was set up which was essentially

PLATE I.



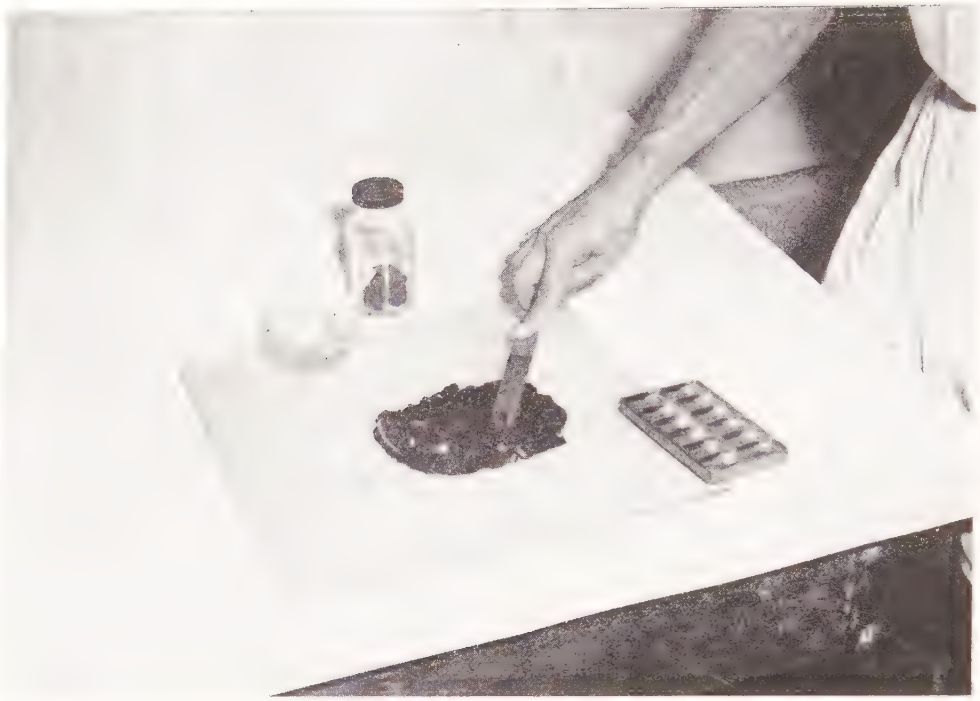
The original Microfermentary.

PLATE II.



Mill used for grinding nibs and chocolate. The bottle contains nibs from one pod, hand-ground ready for milling.

PLATE III.



Tempering and moulding of milled nib. Fluid paste has been spread on the glass slab for tempering and will be put into Neapolitan moulds.

PLATE IV.

Tempering and moulding of chocolate (i.e. milled nib, with sugar and cocoa butter added). Solidified tablets have been removed from the mould.

an electrically heated water bath with thermostatic control and a mechanical stirrer. The water bath was covered with a plywood lid in which holes were made to fit six beakers, the thermostat, stirrer and a thermometer. The temperature was controlled by using a Sunvic T.S.2 NC thermostat with six-inch stem. The plywood lid warped, and later models were made of 1/16 in. Formica on a Meccano frame, which was found satisfactory. Compact electric kettle heating elements were used instead of the wide, water-bath heating type because they occupy less space. It was not necessary to provide constant level water inlets as little evaporation takes place in such a unit at fermentation temperatures.

Fermentation and Drying.

The following standard procedure was adopted for the preparation and fermentation of single podfuls of beans. The pods are weighed and opened on the day of harvesting. Sound and flat beans are counted and weighed. They are then spread on clockglasses and left exposed to the air for one hour as practised by De Witt, and afterwards placed in 400 ml. beakers, one podful to each beaker. In the bottom of the beaker there is an inverted watchglass. The beans are covered with a thin layer of moistened cotton wool and then by a thick insulating layer of dry, non-absorbent cotton wool. Each beaker is covered with a wrapping of 0.003 in. thick polythene sheet held in position by a rubber band. The beakers are placed in the water bath and allowed to hang into the water, being supported by their rims which rest on the lid.

The beans are incubated for four days at 35°C and then for three days at 50°C. Once each day they are removed from the beakers, the drainings are discarded, the beans mixed gently by hand and replaced in the beakers and incubation is continued. Two water baths were made, one set to operate permanently at 35°C and the other at 50°C. so it is merely necessary to transfer beakers from the lower to the higher temperature bath without having to alter the thermostatic settings.

At the end of the seven-day fermentation the beans are washed free of adhering pulp and then put on rattan trays to dry. They are sun-dried for half an hour on the first day, one hour on the second, and approximately six hours on the third day and then are given full daily exposure in the sun until drying is complete. The total period is about a week. The beans are finally oven-dried for 24 hours at 50-55°C, then weighed, recounted, packed into bottles and stored in an air-conditioned room until they can be roasted.

These times and temperatures of fermentation have been found suitable for Amelonado and Trinitario cocoas and will be used for other varieties until more is known about their particular requirements.

Roasting and Preparation of Nib Paste.

The dried beans are heated to 100°C for ten minutes and then roasted for one hour at 140°C in an air oven. Beans are again weighed, the shell and the germ (embryo) are removed by hand and the weight

of the resultant nibs is recorded. The nibs are reduced by pestle and mortar (for five minutes) and then ground by passing twice through a small, electrically driven Pascall triple-roll mill, using wide settings for the first run and closer settings for the second. The cocoa is by this time usually fluid enough to be tempered without further heating. Tempering is done by working the molten cocoa mass with a flexible spatula for about ten minutes. The cocoa is then placed in moulds and cooled in a refrigerator overnight.

Chocolate Making and Tasting.

The ingredients used are nib paste, icing sugar and de-odorised cocoa butter in the proportion of 10, 13 and 4 parts by weight respectively. This mixture is first ground in a hand mortar and then passed twice through the triple-roll mill using a close setting of the rollers. The chocolate is heated slightly in a water bath and tempered and moulded in the same way as nib paste. After cooling, the moulded tablets are bottled and left to mature for a week in a refrigerated room before tasting.

For tasting, De Witt's classification of taste characteristics (5) is used as a guide. Most attention is paid to the presence or absence of chocolate flavour and a comparison of its strength with that of other standard chocolate. For routine selection work, samples with a positive chocolate flavour and containing no off-flavour are usually classified simply as "satisfactory".

Summary

Reasons for cocoa fermentation and some of its effects are given. Methods and apparatus for fermentation experiments with small quantities of beans are outlined. A multiple microfermentary for routine selection work and a procedure for chocolate making are described.

Acknowledgements

Thanks are due to Messrs Cadbury Brothers, Ltd., for their advice and guidance in these experiments and for valuable comments on the various samples sent to them from time to time for appraisal.

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MASTER FARMERS OF MALAYA, V.
ABDUL MANAN BIN PAWIROH

BY

E. F. ALLEN,

Formerly Acting Deputy Director of Agriculture.

Introduction

Sixty-eight years ago Abdul Manan bin Pawiroh was born in Kutawinangon district of the State of Kebumen, in Central Java. His family had connections with Malaya and so, in 1922, he emigrated and settled in the small kampong of Kanchong Darat in the Kuala Langat district of Selangor. When he first came there were only 140 houses in the kampong; now there are 700 and he has been the Ketua Kampong of this thriving agricultural community since 1930.

Abdul Manan is a remarkable man in many ways. He is young for his age, an excellent former and he appreciates the need for intensifying crop production when good agricultural land is in short supply.

Coconut and Coffee Cultivation

.The people of Kanchong Darat are fortunate in the high fertility of their soil which is a well-drained organic clay with a muck (high-humic) topsoil. Such land is first class for the cultivation of coconuts and Liberian coffee and these two crops form the basis of Abdul Manan's agricultural holding of six acres. This land is fully planted up with coconuts which are underplanted with coffee—a most suitable cropping combination since the coffee shades out all the weeds and the palms benefit from the reduced competition. Not only does this interplanting provide Abdul Manan with an insurance against the failure of either crop but also the combined yield is greater than if comparable areas were single-cropped.

Abdul Manan is a great believer in both self sufficiency and growing more than one crop: he also believes in feeding well. If you visit his holding you will find that scattered throughout the coconut palms and coffee bushes are fruit trees of all kinds and patches of vegetables, foodcrops and spice plants. I noticed the following healthy fruit trees: mango, chiku, durian, papaya and banana. His vegetables and foodcrops include chillies, keladi, tapioca, brinjal, terong rembang, chekor manis, sugar cane and pineapples. Among the spices, herbs and medicinal plants he grows are pepper, kenchor, temu, kunyit, pandan wangi and serai.

There were also several healthy kapok trees from which his children collect floss in season for stuffing mattresses and pillows.

Livestock

Abdul Manan owns one bullock and six goats. There is no grazing for the former on his land, so he sends it to graze on some nearby

waste land and houses it in a small shed. The cattle manure is composted with rubbish and wood ashes and this he uses to manure his vegetables.

Goats can do a lot of damage on a mixed holding and these are kept in a clean wooden shed and stall fed on cut grass collected from road verges and drain edges.

Abdul Manan was apologetic about the size of his poultry flock. Many had been slaughtered recently for a *kenduri* and he only had about forty head. However, he keeps half-a-dozen doves in a clean, well ventilated shed close to his house and the young 'squabs' or full grown nestlings provide a most tasty and nutritious meal for the family.

Gross Income

Abdul Manan sells only coffee berries and coconuts; yields of both varying from month to month. Coconuts are harvested every two months and they yield an average of 1,800 nuts per acre per year. These are large nuts and 230 of them produce a pikul of copra; hence this is equivalent to a yield of 7.8 pikuls per acre of copra, which is quite a fair crop.

The Liberian coffee is harvested monthly in season but there are usually only about six harvests per year. The cropping unit is a four-gallon tin of ripe berries and an acre averages 93 tins per year. The processing dealer buys these at present (January, 1958) for 75 cents per gallon. A four-gallon tin of berries yields some 2½ katis of prepared coffee so this is equivalent to a yield of 232½ katis (310 lb.) of coffee beans per acre.

The gross income obtained from the six acre holding is thus as follows:—

Crop	*Yield per acre*	*Yield per 6 acres*	*Price*	*Income ($)*
Coconuts	- 1,800 nuts	10,800 nuts	7½ ct.	810
Coffee	- 372 gallons	2,232 gllaons	75 ct.	1,674
				$2,484

Naturally, a considerably greater cash income would result if Abdul Manan processed his nuts and coffee himself and doubtless he would do this if he ever found himself short of cash. The processed yield and its value would be approximately as follows:—

Crop	*Processed Yield per 6 acres*	*Price per pikul*	*Income ($)*
Coconuts	47 pikuls copra	$ 28	1,316
Coffee	13.95 pikuls coffee	$150	2,093
			$3,409

A few years ago Abdul Manan acquired an acre of old rubber not far from his other two holdings. It is bad land utilization to grow

rubber on rich alluvium, especially when better yields can be obtained on the poorer inland soils. Hence his decision to replant with coconuts and coffee served both his country's interest and his own. Subsequent growth has been good and the three-year-old coffee is just beginning to yield some fruit, while the growth of the young coconut palms has been good.

Labour Requirements

Abdul Manan has no labour problem as in this—as with his cropping—he believes in self sufficiency. With justifiable pride he told me that 16 of his 21 children are living today and 33 of his 37 grandchildren. He even has had two great-grandchildren of which one survives and many more are expected.

Discussion

It is often said that Malaya has unlimited good agricultural land but that is by no means so. In fact, most of the country's best food-producing soil—namely its coastal alluvium—has already been exploited, except for the areas now blanketed by a deep deposit of peat. This coastal alluvium is the land on which are produced today some of the highest yields in the world of padi, coconuts and palm oil. There will come a time when the world's rapidly increasing population will need all these foodstuffs, and more, in order to keep hunger away. It is on just these soils that no other form of agriculture can be justified except the intensive cultivation of foodcrops—in fact just the type of husbandry now practised by Abdul Manan. As befits a Ketua Kampong he provides a fine example to his *anak-anak buah* and there is perhaps a lesson here for estates. Let us see to it that all such Master Farmers are settled on to the best land available and not wait until a hungry world forces on us a belated land reform.

Let there be no further sacrifice of these fine soils to mining and let us give every encouragement to farmers and planters to replace second-rate rubber with first-class padi, oil palms or coconuts, with the last fully intercultivated with pineapple or coffee, fruit trees or cacao Rubber and tin we must have to maintain Malaya's high standard of living and to provide new schools and colleges, but let these sources of weath come from the poorer inland soils so that a balanced agriculture will develop from correct land utilisation.

"What use is education to an empty belly?"

(The Minister of Agriculture, Inche Abdul Aziz bin Ishak,
December, 1957)

PLATE I

Abdul Manan welcomes his visitors at the entrance of his mixed holding. Note the healthy bushes of Liberian coffee.

PLATE II

Abdul Manan with a few members of his family.

PLATE III

Liberian coffee almost ready for harvesting. Some leaves have been removed for this picture.

PLATE IV

A good crop of pepper ensures a plentiful supply for his family's use.

PLATE V

Liberian coffee and coconuts grow well together on Abdul Manan's holding.

PLATE VI

Abdul Manan discusses the quality of his chiku fruit with Abu Bakar bin Ali Basha, Agricultural Assistant for Kuala Langat and Telok Datoh

MASTER FARMERS OF MALAYA, VI.
HAJI AWANG BIN HAJI NASIB

BY

ZAINALABIDIN BIN MAAMOR,

Cadet Agricultural Assistant.

Introduction

Haji Awang bin Haji Nasib, 39 years old, is a Malay of Banjar ancestry. He began his life as a padi farmer at Bagan Tiang, Krian, in 1945, the year when he decided to leave his father's home to start life on his own. Starting modestly with 3½ acres of padi land given by his father, he is now the proud owner of 18 acres. All his lots are graded as Class I land within the Irrigation Area of Krian. This commendable success has been achieved during the short period of 12 years through hard physical work and outstanding business ability.

In the 1956—57 season with the help of his grown-up sons he was able to plant 14 acres of his land with padi. This is the highest acreage to date that he and his family have planted. The remainder of his land is rented to other farmers.

The methods of cultivation adopted by Haji Awang are the same as practised in other parts of Krian. The land is cultivated by means of the *tajak* or short scythe and double transplanting of nurseries is carried out. All the preparation of the land is undertaken by himself and his family, but for the transplanting of seedlings in the field he engages other farmers.

Seed Selection

Where Haji Awang differs from other farmers in the area is that he carefully selects his seed padi in the field every year for the next season's planting. By doing this he ensures that the padi seed he has reserved is better than the average of the preceeding crop. Mayang Sabatil is the popular variety grown. The adoption of seed selection has enabled him to maintain good yields of padi from year to year with an average of about 500 gantangs per acre. The fact that he is able to maintain his yields at a constantly high level has been entirely due to his proper seed selection coupled with strict adherence to gazetted planting dates, maintenance of clean bunds, regular weeding of the growing padi and good control of pests and diseases.

By the adoption of seed selection, Haji Awang also produces high quality padi. He is a keen exhibitor, and ever since the inception of padi competitions in the district his padi exhibits have never failed to win a prize. For the last two years his exhibits of the variety Mayang Sabatil were judged to be the best in both the District and State Competitions respectively, thus earning him the title of the Champion Padi Farmer in Perak. He is now well known to the padi farmers in Krian and an example for them to follow.

Water Melon and Fish

Haji Awang demonstrates his business ability in his farming practice. He strongly believes that agricultural land must be utilised to give maximum benefit to man. Other farmers are satisfied with planting padi only, but Haji Awang realises that the bunds dividing his fields can be used to plant other crops. During the planting season the bunds are fully planted with water melon. He obtains an average harvest of about 50 *pikuls* of water melon each year, which at a price of $14 per *pikul* supplements his income by $700 per annum. In addition he has eight fish ponds on the low lying areas of his farm which provide him with approximately 24 *pikuls* of fish. At a price of $10 per *pikul* this earns him a further $240 per annum.

Discussion

Years of experience in planting padi have taught Haji Awang most of the techniques required. This, however, has not made him conservative or averse to new ideas for improving his yields of padi. This year the Department of Agiculture is carrying out smallholder varietal extension trials with Seraup 50, a new strain under selection at padi stations in Krian, which has so far shown great promise. This is done to test the suitability of this strain under smallholder conditions, and Haji Awang is one of the farmers in the district who has readily and willingly co-operated in laying out this trial on his own land. The future success of this new seed will depend much on such farmers as Haji Awang who are willing to try it out, and when proved, to encourage its use.

Haji Awang is a fine example of what a paid farmer in this country can achieve. The fact that one is a padi farmer is no reason for poverty. Given the right conditions, the knowledge, the industry and the ambition, a padi farmer need not be poor at all, for men like Haji Awang have proved this. He has been to Mecca once and is already thinking of going again next year. Haji Awang is certainly one of the "Master Farmers" of this country.

PLATE I

Haji Awang uses a sickle to harvest his heavy crop of padi.

PLATE II

Haji Awang threshing his padi in a *tong* (wooden tub).

PLATE III

At the Perak State Padi-Competition Haji Awang won these two silver cups.

NOTES ON CURRENT INVESTIGATIONS AND EXTENSION WORK

October to December, 1957.

Weather

The quarter was generally wet with exceptionally heavy monsoon rainfall occurring in the Pahang Tua area of coastal Pahang. Padi areas in the riverine mukims were flooded but damage was relatively localized. In Selangor there were severe prolonged floods in the coastal areas and considerable damage was caused to permanent dry-land crops.

Padi

Research

Analysis of the results of experiments for the previous season have been completed. No significant differences have been noted between the yields of six Pahang varieties in trials at Kerdau Padi Test Station or between the ten medium-long term varieties at Gerai Padi Test Station, Trengganu.

In the hybridisation programme for *penyakit merah* resistance, F_1 hybrid progenies recently harvested showed hybrid vigour, some plants being over 76 in. tall. Yields were good and sterility low. Progenies from X-ray mutants back-crossed to Siam 29 have come into flower and sterility appears to have been reduced, while strong straw characteristics of the mutants have been largely maintained. In breeding for stem-borer resistance, cross-pollinations between the resistant wild rice *Oryza ridleyii* and other varieties have generally failed to set seed.

The field insecticidal spraying experiment for control of padi stem-borers was laid down on 19 padi test stations in all parts of the Federation. This experiment is designed to show whether one application of insecticide, applied four weeks before flowering, will reduce borer attack and give an economic increase in yield.

Incidence of borers has, as in the 1956-57 season, been low; the highest percentage of tillers bored has been found in the Krian area of Perak and the lowest in Malacca and Kedah.

Detailed observations are also being carried out to assess the build-up of borer populations during the season, with the object of discovering some method of forecasting the intensity of borer attack during the later stages of growth of the padi.

Work on the minor element requirements of padi has continued and very striking symptoms of manganese and zinc deficiencies have been noted; zinc deficiency in particular gives a marked bronzing of the leaves.

Analyses of padi plants from some high yielding plots at Sekinchang, Selangor, have been carried out. Under conditions of deep flooding the uptake of nitrogen, phosphorus and potassium is reduced while that of manganese and iron is increased.

In the northwest, crop prospects are generally good, especially in Province Wellesley. On the East Coast they are very good in Kelantan and Trengganu. Farther south, however, there was considerable flood damage reported in the Pahang riverine areas.

In Selangor there has been an increase in planted area of 5,000 acres and prospects are generally very good in spite of delayed transplanting caused by floods. Elsewhere crop prospects are generally good.

In Perak excellent progress has been made in the colonization of a further 500 acres in Changkat Jong, bringing the total planted area there to 2,860 acres, about 97 per cent of the plantable land.

In the current season over 2,500 fertilizer demonstration plots have been laid down in the different States. Most of these were of the two-plot type with fertilizer applied to one plot. However, a number demonstrated nursery manuring and improved management in general.

Sales of subsidized padi fertilizer in Kelantan have totalled 1,348 tons for the season as compared with 817 tons in 1956. In Trengganu some 380 tons have been sold as compared with a target figure of 288 tons.

During the quarter sufficient padi fertilizer was sold in Negri Sembilan and Malacca for a further 990 acres.

Some 6,712 *gantangs* of selected seed have been distributed during the quarter and also 3,648 *gantangs* of unselected seed.

Rat damage and attacks by various insect pests have been widespread and prompt remedial action has been taken by Departmental pest gangs. Over 2,100 lb. of rat poison has been distributed free and also 760 lb. of various insecticides.

By the end of the year the early wet padi (*padi menghulu*) on the East Coast had been harvested and harvesting operations were in full swing in Kedah and Perlis. Some very satisfactory yields have been reported.

Yields from lowland dry padi in Kelantan and Trengganu have been rather low, largely because the very wet weather restricted weeding.

Some excellnt crops of upland dry padi have been reported from several States. Damage by the locust, *Patanga succincta*, has been widespread, notably in Ulu Trengganu, at Lenggong in Upper Perak and at Titi Akar in Kedah. Most of these attacks have been controlled by Departmental gangs using Dieldrex 15, miscible DDT or BHC.

The transplanting of padi in various manurial and cultural trials in the southern part of the peninsula was completed early in the quarter. Trials planned in the double-cropped districts of Penang were also laid down.

The new seven-plot extension trial programme planned for the present season is operating successfully in Kedah where it is under the effective supervision of a Padi Agronomist.

The padi mechanization scheme at Parit in Central Perak has run into the same difficulties as were experienced last season. The crop was successfully drilled in September-October and initial growth was good

but as a result of mechanical defects in the pumping units, water was not available over a considerable part of the crucial post-establishment period. Deficiencies in the internal irrigation system have been corrected by the construction of a high-level internal distributary but the overall lack of water resulted in arrested padi growth and severe weed infestation. Hand weeding had to be resorted to and a portion of the crop had to be abandoned. The resumption of normal water supplies brought about a noted improvement in growth and a reasonable crop is expected from the weeded areas.

Rubber

A further 10.6 million clonal seed have been distributed and sown in nurseries during the quarter. Sales of planting material to smallholders were as follows:—

Distribution	*Budwood (yd.)*	*Clonal Seedling Stumps*
To new planters	18,054	1,008,874
To re-planters	76,584	4,206,451
Total	94,638	5,215,325

Supplies of clonal seedlings have been adequate to meet all demands.

The executive control of Government Pool clonal seedling and budwood nurseries involves Departmental Officers in a great deal of work. This is best illustrated by quoting the number of nurseries supervised by the Department:—

Type of Nursery	*Number*	*Area (acres)*
1956-57 clonal seedlings	40	146
1957-58 clonal seedlings	56	432
Budwood	44	101

Purchases of smallholders' rubber at latex collecting centres in Perak, Johore and Kedah have been equivalent to 4,818 *pikuls* of dry rubber.

Coconut

The planting of young palms in progeny trials at the Federal Experiment Station at Telok Bharu has continued during the quarter. As a result of the erratic supply of nuts from the mother palms it has been necessary to use some over-age seedlings for each plot planting. This is reflected in poor condition of the progeny immediately after transplanting and it has been necessary to amend the manurial programme in an attempt to overcome this difficulty. Thirty-five acres of land previously cleared for the 1958 planting programme has been successfully put down to cover crop. A further 10 acres of land has been cleared and drained.

Manurial observations conducted at Blenheim Estate in the Bagan Datoh district of Lower Perak have suggested that nitrogen, phosphate and magnesium are the more important requirements of palms on the heavy clay soil of the delta. The laying down of formal experiments on the estate is under discussion as it is felt that the result would have widespread application to both estates and smallholders in the district.

In a manurial trial on smallholders' land in Trengganu the manured plots continued to yield substantially more nuts than unmanured plots. The figures for the quarter are as follows:—

No. of Nuts Harvested Per Treatment

Manured with 14 lb. NPK Mixture per palm per annum	*Manured with 7 lb. NPK Mixture per palm per annum*	*No Manure*
972	902	579

A new disease of mature coconut palms has appeared in south-western Johore and is most noticeable in the Batu Pahat district. After Research Officers had made preliminary inspections, a field survey was carried out during December by students of the College of Agriculture and Johore field staff. This has revealed that in a random sample of 109 half-acre plots there was a total of 35 diseased palms, of which 26 were in the age class of six to 40 years. Survey data are now being studied and the disease is under active investigation.

This disease shows signs of slow spreading and field staff from other coconut-growing areas on the West Coast have acquainted themselves with the symptoms. No signs of the disease have been seen in other States.

Prices for smallholders' copra have ranged from $21.50 to $28 per pikul according to locality. Disruption of the Indonesian trade has apparently caused the increase. Nuts have sold at $7.50 to $9 per 100.

The 23 manurial demonstration plots in Kelantan and Trengganu have aroused considerable interest amongst growers because of the colour change in fronds as a result of manuring.

Cacao

Pollinations between the 'original' Upper Amazon clones at the Federal Experiment Station, Serdang, Selangor, have been made with a view to providing seed for planting a progeny trial at Jerangau.

A test was carried out to compare the amount of residual deposits on cacao leaves given by dry fogging, wet fogging and mist blowing, using a fluorescent tracer. Results indicated that both types of fogging give some deposit, but only on trees close to the line of fogging. As expected, mist blowing was considerably more efficient in this respect.

A reasonably good crop was harvested at the Federal Experiment Station at Jerangau, Trengganu, during the quarter. Fermentation was conducted satisfactorily and the fermented beans were dried on the

recently constructed Cameroon-type drier. The resultant product was judged to be of good quality.

Observations of vigour in pruning trials, carried out at the Federal Experiment Stations at Jerangau and Serdang, have suggested that controlled development of the trees may be a desirable feature.

Symptoms of improper nutrition evidenced by leaf yellowing and die-back of the trees were less conspicuous during the quarter. This subject received considerable attention during the period under review and a survey was conducted to indicate the severity of the problem. It has not been possible to correlate the symptoms with ecological or other factors. Calcium deficiency has been definitely defined and it is hoped the analysis of data from a manurial trial now being conducted will provide further information of value in the near future.

Growth of Amelonado cacao in Block IV of the Kampong Awah seed garden in Pahang has been very good and, although shade is light, there is a complete absence of grass weeds. Heavy squirrel damage has been experienced and a trapping and shooting campaign has commenced.

In the Jerangau Pilot Scheme, Trengganu, planting of the remaining 30 acres commenced at the end of September and was completed by the end of the year. Growth of seedlings which were planted out in 1956 was satisfactory and there was no damage by pests and diseases.

An observation plot of cacao on Glugor Estate, Penang, has shown such satisfactory growth that the Manager is extending the planting under mature fruit trees.

Oil Palm

In connection with the co-operative breeding scheme, Trials III, IV and V were planted on a Selangor estate and arrangements finalised to plant trials on two Johore Estates. *Tenera* palms of the Federal Experiment Station, Serdang, have been pollinated with *pisifera* pollen obtained from West Africa. It should be possible to grow improved *pisifera* palms from the seeds so obtained.

Basal stem rot caused by *Ganoderma lucidum* continues to cause concern on several estates. This disease was previously thought to be of minor importance as only old palms were attacked, but now large numbers of palms on several estates are being killed by it, including several eight-year-old palms on an estate in Perak. This occurrence of the disease on young palms makes it potentially much more serious.

Pineapples

There have been good crops recorded in Selangor and the Klang Cannery has purchased 2,674,645 lb. of smallholders' fruit. In Perak the Jendarata Cannery has bought 310,799 lb. of fruit from small growers at Kampong Selabak.

In Johore, canneries were able to deal with the heavy crop harvested but the rate of rejection of fruit is still very high. Extensive flooding in the Ayer Hitam area of Muar district spoiled much of the crop.

At Jeram Batu, also in south-western Johore, a further 30 acres were planted during the quarter and the standard of cultivation has been very high indeed. The Pekan Nanas Co-operative Society purchased 130 tons of fertilizers on behalf of its members.

Investigations into agronomic problems in pineapple cultivation are gradually being terminated and responsibility for such investigations is to be handed over to the Malayan Pineapple Industry Board.

Fruit

Rambutan clonal trials at the Federal Experiment Station at Serdang and Cheras Agricultural Station came into harvest at the end of the quarter. The clones R.132 and R.136 included in the Cheras trial are proving to be of not particularly good quality.

A technique of pulling valuable budded rambutan stumps and successfully transporting these over long distances has been developed. It is considered that this technique may prove to be a useful asset in the distribution of new clonal material.

The Department sold 10,970 budded fruit trees during the quarter and commercial nurseries have sold a further 3,525.

The neck orange known locally as *limau chembol* grows well in Kedah and Kelantan and 1,000 seedlings are being raised in the former State for observation planting. A small commercial orchard of 35 trees yielded 20,000 fruit during the quarter and these were sold, ex-orchard, at 10 cents each.

In Johore there has been a heavy harvest of mandarin oranges in the Muar and Segamat areas.

In Kelantan and Trengganu good work has been done on the demonstration holdings belonging to Progressive Farmers. The Department demonstrates manuring and pruning techniques on these holdings.

At Ajil Agricultural Station, Trengganu, a half-acre demonstration plot has been planted with the interesting fruit-tree *salak*. This spiny palm yields a high-value fruit and it grows particularly well on the fertile river alluvium in this State.

Coffee

The Klang price for dried beans of Liberian coffee rose from $144 to $154 per pikul during the quarter.

In the Kuala Selangor district, serious prolonged flooding of coffee holdings and of coconut areas interplanted with coffee has caused considerable losses of both mature and young bushes. About 350 acres have been totally destroyed and there has also been serious damage to an equivalent area in the Klang and Kuala Langat districts in the same State.

A sample survey of a well-farmed coconut and Liberian coffee holding in Kuala Langat suggests that this combination of crops is very suitable for smallholdings and it seems likely that the yields, with underplanted coffee, are greater than if each crop were planted seperately on half of the holding.

A revised leaflet on coffee has been prepared for publication in three languages .

Cloves

Another 200 clove trees have been planted in Penang, which brings the total to 12,360 on the island. Growth of this crop has been very satisfactory in observation plots in Trengganu and Malacca.

Tobacco

A second experiment to investigate the possibility of controlling bacterial wilt (*Pseudomonas solanaccarum*) of tobacco by the use of DD soil fumigant was carried out. Soil fumigation reduced the number of plants affected by the disease, but did not eliminate it.

In another experiment it was found that this disease could not be controlled by spraying tomato plants with an antibiotic (agrimycin). Further experiments are in progress.

Tea

More planting was carried out in the important clonal collection of lowland tea at the Federal Experiment Station at Serdang. Certain clones are now in plucking and yield records are being taken.

A trial at the Federal Experiment Station at Cameron Highlands continues to show that greatly increased economic return is obtained from the application of nitrogenous fertiliser.

Pastures, Fodders & Livestock

A Guinea grass variety trial was laid down at the Federal Experiment Station, Serdang, during the quarter. This trial compares the yield of four imported strains with the local strain at two spacings.

A feeding trial in which Bali cattle are stall-fed entirely on Guinea grass has shown that entire animals can increase more than 1 lb. live weight per day on a diet of grass alone. Castrated animals have shown less satisfactory daily increases.

Growth in Stylosanthes plots in Kelantan continues to be satisfactory. By the end of the year there were about 200 of these plots established, the area of each varying from 1/40 to ½ acre.

Departmental sales of pigs have totalled 30 boars and 31 gilts. In addition, 641 services have been carried out in new villages and 339 at stud farms.

Sales of poultry for breeding purposes totalled 99 cockerels, 79 pullets, and 57 ducks. 1,039 hen eggs and 137 duck eggs were sold for hatching. in addition to 15,438 eggs sold for consumption.

Soil Surveys

A preliminary field trip in the rather inaccessible Sungei Lebir valley of Kelantan, indicated that this region may include large areas of potential agricultural land and more detailed examination will be carried out during 1958. A reconnaissance survey was made in the Kluang area

of Johore. Some correlations were noted between these soils and the soils of the western side of Singapore Island. Soil surveys were carried out on two potential development areas in Malacca and detailed soil maps were made of areas covering 1,500 acres.

A reconnaissance survey was made of over 6,000 acres of coastal land in Province Wellesley, with a view to assessing to what extent the land will benefit from drainage. As a result of this survey it was concluded that some 3,700 acres would benefit very considerably; the remaining area, however, was composed of very poor sandy soil containing some peaty layers, which would derive no great benefit from drainage.

Food Preservation

Experiments on canning of ginger roots of various ages have been carried out, and five-month-old roots have proved to be the most suitable for canning.

Batches of mandarin oranges at various stages of ripeness have been received for canning trials. Owing to the presence of seeds in over 90 per cent of the segments, the product is of a very low standard compared with that of the Japanese.

Samples of concentrated pineapple juice have been prepared. Examination at monthly intervals has so far revealed no deterioration.

Plant Diseases

A hitherto unrecorded disease has been reported on oil palms in Johore. In this disease, brown, rotten areas develop on the leaves in the unopened spear; a species of *Fusarium* appears to be the cause of the disease, which is still under investigation.

A witch's broom disease of sweet potatoes, in which growth is stunted and many short branches with very small leaves are produced, is suspected to be caused by a virus. A similar disease has been recorded in Indonesia.

Symptoms on lime trees at the Federal Experiment Station at Serdang suggest that the trees may be affected by the obscure virus disease *tristeza* (quick decline).

Suspected virus diseases have also been observed for the first time on soya beans and *Clitorea* species.

Education

Four Malay and one Chinese newsletters were published in Penang, Kelantan, Trengganu and Malacca, and a total of 42,000 copies were printed and distributed free during the quarter.

During the period under review 348 students attended courses at Rural Agricultural Training Centres in nine States. These included the first courses to be held in the new centres at Bukit Temiang, Perlis, and Sungei Udang, Malacca. In Trengganu the centre at Ajil has now been completed. Perak is now the only State without a Training Centre.

132 students have attended padi cultivation courses at Bukit Merah Padi Experiment Station in Penang State.

Development Schemes

At Ayer Lanas, Kelantan, good progress has been made with the establishment of house lots which are now fully planted-up with vegetables, banana, tapioca, pineapple and other foodcrops. Some 320,000 rubber seedlings have been established in nurseries for budding in mid-1958. They will then be used as budded stumps.

Unfortunately 300 out of 400 acres of lowland dry padi at Ayer Lanas were destroyed by heavy floods in December.

Three development schemes are planned in Negri Sembilan.

Community development schemes have commenced in three *kampongs* in Perlis and it is reported that these have made a promising start.

Three areas totalling 5,266 acres have been set aside for block new planting of rubber in the Pekan district of Pahang.

The Bukit Goh Development Area in Pahang is to be opened up for timber extraction in 1958. Final soil reports indicate that about 10,000 acres of volcanic soil are available; this will be divided between estates and smallholders for planting tree crops, including cacao.

At Jaya Stia, Kuala Selangor, the ex-Special Constables have now requested permission to plant rubber on the land as recent floods have destroyed all their Liberian coffee.

At Padang Temak, Kedah, maintenance of newly planted rubber and cover crops in the development scheme has been of a low standard.

In the new development scheme at Kampong Bali, Perak, excellent progress has been made. Here 132 acres of rubber land has been contract cleared, ploughed, harrowed, fenced and planted up with rubber by 44 families. The colonists are ex-Special Constables.

REVIEWS

A Textbook of Plant Virus Diseases

By Kenneth M. Smith, ***Pp.*** *vii + 652 + 93 fig. (Boston: Little, Brown & Co. 1957.) 65s.*

The first edition of this book appeared in 1937 and since then has been an invaluable reference text to those dealing with virus diseases. During the past 20 years, however, a large amount of work has been carried out on this group of diseases and much new information has come to light. The second edition of the book is therefore welcome, including recent information formerly available only in scattered articles in numerous periodicals.

The arrangement of the book is simple, the viruses (over 300 in number) being listed in alphabetical order of their popular English names. Each name is prefixed with the name of the principal plant affected by the virus (e.g. coconut cadang-cadang disease, rice dwarf), so that in effect the viruses are arranged in alphabetical order according to their main host plants. Each virus is concisely but thoroughly dealt with under the headings synonyms, description of the virus and its transmission, the diseases it causes, its host range, geographical distribution and control. References to key papers are also given, these references being listed at the end of the book. The book is completed by an index of virus disease synonyms. Many of the diseases are illustrated by photographs.

The author in his preface points out that because of the alphabetical arrangement of the text a subject index is not required. It would, however, seem that the inclusion of a host plant index would have increased the value of the book. Without such an index it is impossible to discover which viruses affect plants other than those from which the viruses received their names unless a tedious search is made through the text of the book. In a country such as Malaya, where very little is known about the local plant virus diseases, such information is likely to be sought in the book and the lack of a host index is a disadvantage.

Minor errors or omissions are inevitable in a book of this type One which will strike readers in this part of the world is the omission of North Borneo from the geographical distribution of Abaca Bunchy-Top Virus.

Dr. Kenneth M. Smith is to be congratulated and thanked for producing this second edition of his book, which will find constant use among all workers concerned with the virus diseases of plants.

A.J.

The Oil-Palm, its Culture, Manuring and Utilisation.

International Potash Institute, Berne, ***Pp.*** *106.*

The publication is a useful, compact source of information on oil palms and with the "Oil Palm in Malaya" now out of print and in parts out of date it is the only available book published in English.

The introduction gives some interesting tables on the production of oil from various crops and shows how the oil palm gives a vastly greater yield of oil per acre than its nearest rival the coconut palm. However, of the 16.5 million tons of vegetable oils produced annually the oil palm only produces about 1.3 million tons and Malaya's share of this is comparatively small, being only 58,000 tons in 1957.

The booklet gives a short but useful description of the various varieties, briefly noting the use of *pisifera* and *tenera* material in recent breeding programmes. In the section on conditions for growing oil palms emphasis is rightly placed on rainfall. The high rainfall and even distribution in the high yielding areas of Sumatra are in contrast to some of the oil palm growing areas in Nigeria. The description of the proper soil is the characteristically vague "deep medium loam, rich in humus".

As regards manuring, attention is directed chiefly to work in West Africa where the need is largely for potassium magnesium fertilisers. Some results are quoted for Sumatra but such results are not applicable to the coastal clay soils of Malaya, where oil palms are being increasingly planted. Some doubt is cast on the validity of leaf analyses as a method of determining nutrient requirements but no mention is made of the work of Chapman and Broeshart in correlating leaf analyses with yield. The description of harvesting and utilisation of the oil palm fruit will be familiar to the oil palm planter but the section gives a useful account of this subject for the unitiated.

J.K.C.

Illustrated Glossary of Rice Processing Machines

United Nations Food and Agricultural Organisation.

At the 1956 meeting of the International Rice Commission held in Calcutta, an *ad hoc* working group on Storage and Processing of Rice, recommended that a glossary on rice milling terms should be produced. The result, "Illustrated Glossary of Rice Processing Machines", published by F.A.O., should go a considerable way towards fulfilling this recommendation.

The Glossary in its present edition includes drawings of the most commonly used types of classical rice processing machines with relevant terms and designations of the machines and their main parts in three official languages—English, French and Spanish. Tabulation of the relative terms makes for easy reference.

The publication introduces its subject by illustrations of the padi grain and then goes on to give, in tabular form, the various operations performed in a modern mill, the by-products obtained from each, and the types of machines used to carry out such operations. Eighteen such machines are illustrated by well annotated diagrams.

The publication also gives descriptions of three types of handling equipment as well as some details of apparatus for dealing with spare parts. Finally, there are details of rice sampling equipment, including a rice trier, rice sample divider, a moisture tester, and a sampling mill.

J.K.C.

STAFF NOTES

(To 31st March, 1958)

Promotions

Name	*Promoted as*	*Date*
J.L.B. Hitchcock	Senior Agricultural Officer, Grade A	13.10.57

Appointments

Correction : Mohd. Noor bin Haji Abdul Hamid was appointed Assistant Agricultural Officer, Trengganu, on 30.10.57, not Acting State Agricultural Officer as previously reported.

The following appointments have been made:—

Name	*Appointed as posted as*	*Date*
C. Whitehead	Acting Senior Agronomist	18. 1.58
J.S. Ure	Acting State Agricultural Officer, Kedah	26. 1.58
P.G. Coleman	Acting Assistant Director of Agriculture (Field)	26. 2.58
	Acting Deputy Director of Agriculture	29. 3.58
E.F. Allen	Acting Deputy Director of Agriculture	26. 2.58
A.L. Barcroft	Acting Assistant Director of Agriculture (Field)	29. 3.58

Retirements

The following officers have proceeded on leave prior to retirement under the Tenth Schedule to the Federation of Malaya Agreement (Amendment No. 4) Ordinance, 1956:—

Name	*Date*
L.N.H. Larter, Assistant Director (Research)	30.11.57
R. Henderson, M.C., Senior Agronomist	18. 1.58
H.J. Simpson, P.J.K., Deputy Director of Agriculture	25. 2.58
E.F. Allen, Acting Deputy Director of Agriculture	28. 3.58

Leave

The following officers have proceeded on leave:—

Name and Rank	*Date*
J.R. Dunsmore, Agricultural Officer, Federal Experiment Station, Serdang. (Prior to transfer to Sarawak)	13. 2.58
G.I.M. Martin, Agronomist, Kedah	24. 2.58

The following officers have returned from leave:—

Name and Rank	*Date*
J.A. Cox, Development Officer, Headquarters	17. 1.58
P.G. Coleman, Acting Deputy Director of Agriculture	15. 2.58
Dr. J. Dore, Plant Physiologist	19. 2.58
F.B. Brown, Senior Botanist	3. 3.58
F.N.G. Conaty, Senior Chemist	3. 3.58

Notes on Retiring Officers

Mr. E. F. Allen

With the departure of Mr. E. F. Allen, Acting Deputy Director of Agriculture, who left Malaya on retirement leave at the end of March, 1958, the Department has lost a truly outstanding officer.

Mr. Allen joined the Department in September, 1937, as an Agricultural Officer in the Field Branch. From then until 1950, apart from the break caused by the war, he served with that Branch, although, curiously enough, his services for the whole of the period was confined to Perak. In August, 1950, he took over as Senior Agronomist and was promoted to that rank in January, 1955. He was transferred back to the Field Branch in November, 1956, as Assistant Director (Field) and was promoted to that rank in May, 1957.

He volunteered, in 1941, for service with the R.A.F. and left Malaya prior to the outbreak of the Japanese war, thus avoiding the fate of the great majority of his brother officers who became either prisoners of war or civilian internees. He returned to Malaya in September, 1945, with the British Military Administration and immediately became heavily involved in rehabilitating the agriculture of the country.

Apart from being one of the best officers the Department has had in the past 30 years, Mr. Allen made his mark in a number of ways outside the Departmental sphere.

In particular, he was a recognised authority on Malayan natural history and for many years a keen member of the Malayan Nature Society. On orchids especially he was an acknowledged expert and his advice was frequently sought and always valued on this subject.

Among his many other interests may be mentioned his active membership of the Malayan Agri-Horticultural Association, of whose magazine he was the editor in recent years; his resonant voice was well-known on Radio Malaya where he was known as "the Federation's plant man"; he was one of the founder-members and among the staunchest supporters of the "Friends of Templer Park".

A keen rugger player in his younger days, his sporting activities in more recent years have included squash, tennis, rock-climbing and regular turn-outs with the Hash-House Harriers, all of which were tackled with his characteristic enthusiasm.

He and his wife were a delightful couple and they will be greatly missed by a wide circle of friends.

The best wishes of the Department go with them both for a long and happy retirement. Knowing them as we do, we realise that retirement will be just as strenuous an existence as was their life in Malaya.

Mr. D. W. M. Haynes

Mr. D. W. M. Haynes, Agricultural Engineer, left Malaya on retirement in October, 1957.

Mr. Haynes joined the Department at the end of 1949 and since that time served continuously as Agricultural Engineer, stationed at Serdang. Being the first Agricultural Engineer to be appointed in the Department, it fell to his lot to organise the Engineering Division from scratch and this he did to very good effect leaving behind on his departure, a well-equipped and smooth-running Workshop and Pool section, a corps of trained and experienced mechanics and a wealth of published information derived from his many and valuable investigations into the problems of mechanised agriculture throughout Malaya.

Their many friends in the Department will wish Mr. and Mrs. Haynes well in their new venture in Nigeria.

Mr. R. Henderson, M.C.

Mr. R. Henderson, M.C., Senior Agronomist, left Malaya on retirement leave in January, 1958.

Mr. Henderson joined the Department in December, 1947, as an Agricultural Officer in the Field Branch. He served in Johore for his first tour and was then posted as Agronomist in charge Federal Experiment Station, Serdang. Mrs. Henderson rendered very useful service during this period as a lecturer in Biology at the College of Agriculture, Serdang. Mr. Henderson spent a short while as acting Senior Agronomist before being posted to Kelantan as acting State Agricultural Officer in 1954. He returned to Headquarters in 1956 and once more assumed the onerous duties of Senior Agronomist, in which post he was confirmed in May, 1957, and which he held until his retirement.

Mr. Henderson saw lengthy service in Burma during the war as a company commander in an Infantry Battalion, in the course of which he was awarded a Military Cross.

He was a conscientious and hard working officer possessed of that quiet and unassuming manner which readily begets confidence. He set high standards for agronomic research work which, despite the considerable frustration he encountered as a result of a rapidly declining staffing situation, has formed a firm foundation on which the branch will be able to develop.

Mrs. Henderson served the Department very ably as an entomologist for about 18 months prior to her departure in January. Our very best wishes follow them in their future careers in the United Kingdom.

Mr. L. N. H. Larter

With the departure from Malaya in January, 1958 of Mr. L. N. H. Larter, the Department has lost an outstanding research worker and an able Director of Research.

After a distinguished university record at Imperial College, London, and Cambridge University, Mr. Larter joined the then Colonial Service in November, 1932, being appointed to the post of Geneticist, Jamaica. He was transferred to Malaya in November, 1947, as Botanist and was confirmed as Senior Botanist in October, 1952. Subsequently he acted as Chief Research Officer and was promoted to Assistant Director (Research) in January, 1956.

Although he was, for a period, the only Botanist in the Agricultural Department in Jamaica, Mr. Larter became a recognised authority on the breeding and selection of bananas for resistance to Panama disease. With his arrival in Malaya he was immediately concerned in re-starting the padi varietal improvement programme, much of the pre-war benefit of which had been lost as a result of the Japanese occupation. The country is only now beginning to reap the reward of this work and its success points to the sound foundations which were laid by Mr. Larter.

In the last few years he has been concerned with the administration of the Research Branch and his outstanding success in running a branch, which was at times short staffed, is a tribute to his tact and long research experience.

A keen sportsman, he was a very competent performer in many branches of sport from water polo to billiards and his scientific analysis of the correct swing of a golf club was vindicated by the number of trophies he accumulated. A bachelor, a genial host and a connoisseur of music, he was ever a popular member of the Department. Our best wishes go with him in the future years.

Mr. H. J. S. Simpson, P.J.K.

Mr. H. J. S. Simpson, Deputy Director of Agriculture, left Malaya on retirement leave at the end of February, 1958.

Mr. Simpson joined the Department in January, 1931, as an Agricultural Officer in the Field Branch. He served mainly in this Branch until he came to Headquarters in October, 1955, to occupy the post of Assistant Director (Field). There were two periods, however, just prior and subsequent to the war, when he filled the post of Agronomist in charge Federal Experiment Station, Serdang. During his period in the Field Branch he served in the following States: Perak, Selangor, Pahang and Penang. He was awarded the Perak Meritorious Service Medal during his final tour as State Agricultural Officer there prior to transferring to Headquarters. He was promoted to be Assistant Director (Field) in January, 1956 and to be Deputy Director in May, 1957.

During the war Mr. Simpson served with the 2nd (Selangor) Battalion, F.M.S.V.F. He became a prisoner of war when Singapore

fell in February, 1942, and was at Blakang Mati Island for much of the period of his incarceration.

In his work with the Department he was undoubtedly more suited to extension as opposed to field investigation duties. He was ever a hard and conscientious worker. More particularly during his final spell in Perak, he became an ardent upholder of "State rights" but with his transfer to the Federal establishment, he veered to a staunchly Federal outlook, although he never forgot that States, too, have their point of view.

He and Mrs. Simpson made many friends, both within and without the Department, and were always the most pleasant of hosts.

All members of the Department will wish them both a long and happy retirement.

STATISTICS

October to December, 1957

Rubber.—The Singapore price for R.S.S. No. 1 has shown a gradual decline throughout the year from an average of 98 cents in January to 82 cents in December. The disturbances in Indonesia, while causing a temporary hardening of the market, were later discounted as rubber continued to come forward in normal quantities from Sumatra.

In October, November and December the average S.C.C.R.A. prices for R.S.S. No. 1 were 83.51, 77.62 and 82.33 cents respectively. The rubber price has moved more steadily in the year under review, and this may be attributed to the easing of the supply position, due to the availability of synthetic rubber substitutes in America, and to the trade recession there.

Tea.—The London price for Malayan tea fluctuated between 3s and 4s. 9d. per pound for the last quarter of 1957. Production was maintained at the 1,300,000 lb. level for the months October to December.

Coffee.—The reported increase in smallholders' coffee acreage was set off by the loss of 500 acres in Selangor due to floods in November. The price level for the period January to April, 1958, showed an improvement over the previous quarter (Table IV).

Copra.—Only minor fluctuations in copra prices were reported for October to December but the market hardened slightly in the first quarter of 1958 to around $30 to $31 per pikul.

Production for both estates and smallholdings showed an unexplained decline in 1957 (Table VI).

Table I

AVERAGE MONTHLY PRICES PAID BY LOCAL DEALERS FOR SMALLHOLDERS' RUBBER, OCTOBER TO DECEMBER, 1957

(dollars per pikul*)

Grades	Taiping, Perak			Seremban, Negri Sembilan			Batu Pahat, Johore		
	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.	Oct.	Nov.	Dec.
Smoked Sheet No. 1	94.04	89.02	94.22	95.62	89.90	94.99	—	—	—
Smoked Sheet No. 2	91.77	86.89	90.98	92.47	87.53	91.72	91.07	—	91.00
Scrap	42.60	38.48	42.00	53.68	47.88	50.02	30.66	29.50	30.60

* 1 pikul = 133⅓ lb.

This table has been compiled from statistics supplied by the Chief Statistician, Federation of Malaya.

Table II

RUBBER PRODUCTION
FEDERATION OF MALAYA

(long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1956	1957	1956	1957	1956	1957
January -	32,515	36,076	26,428	27,184	58,943	63,260
February -	27,503	27,002	23,848	21,998	51,351	49,000
March -	28,408	25,908	22,433	20,915	50,841	46,823
April -	26,591	26,501	21,647	22,460	48,238	48,961
May -	23,389	27,129	19,703	18,305	43,092	45,434
June -	29,409	29,628	23,109	21,583	52,518	51,211
July -	30,709	32,405	23,807	24,054	54,516	56,459
August -	30,201	32,957	22,927	23,119	53,128	56,076
September -	30,123	31,418	21,774	21,374	51,897	52,792
October -	30,386	33,290	22,455	22,462	52,841	55,752
November -	28,363	34,369	21,179	22,594	49,542	56,963
December -	34,636	32,390	24,058	21,976	58,694	54,366
Total -	352,233	369,073	273,368	268,024	625,601	637,097
Total 1955 -	351,802		285,281		637,083	

This table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

Table III

AVERAGE PRICES PAID IN LONDON FOR TEA

(s.d. per lb.)

For the Week Ending	Malayan		Ceylon		Indonesian		India				Africa	
							Northern		Southern			
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
3.10.57	4	9.42	5	2.50	3	1.21	5	5.14	3	2.90	2	7.64
10.10.57	4	2.41	5	0.78	3	1.58	5	1.19	3	2.13	2	7.53
17.10.57	3	0.93	5	2.33	3	2.86	5	2.52	3	1.07	2	10.82
24.10.57	3	5.56	5	4.29	3	3.43	5	4.46	3	2.34	3	0.86
31.10.57	3	8.42	5	9.39	3	3.09	5	4.88	3	4.39	3	1.33
7.11.57	4	6.59	6	0.47	Nil		5	4.46	3	4.24	3	1.53
14.11.57	3	4.36	6	4.44	2	3.75	5	5.42	3	5.79	3	4.66
21.11.57	4	8.00	6	2.27	3	5.31	5	3.89	3	6.61	3	2.22
28.11.57	3	2.28	5	10.45	3	4.34	5	0.39	3	7.01	2	11.57
5.12.57	4	6.65	5	9.16	3	2.89	4	9.11	3	6.68	2	11.83
12.12.57	Nil		5	9.10	Nil		4	6.95	3	5.60	2	10.71

Table IV

AVERAGE DEALERS' PRICES FOR DRIED LIBERICAN COFFEE BEANS GROWN IN SELANGOR*

(dollars per pikul †)

For the Week Ending	Klang	Kuala Langat
	$	$
11-1-58	152.00	153.00
18-1-58	150.00	153.00
25-1-58	153.00	153.00
1-2-58	157.00	155.00
8-2-58	157.00	157.00
15-2-58	155.00	156.00
22-2-58	155.00	156.00
1-3-58	158.00	155.00
8-3-58	160.00	157.00
15-3-58	160.00	158.00
22-3-58	155.00	155.00
29-3-58	155.00	155.00
5-4-58	155.00	155.00
12-4-58	153.00	155.00
19-4-58	155.00	156.00
26-4-58	155.00	155.00

* These are not the prices paid to smallholders, who sell freshly harvested berries to dealers for processing.

† 1 pikul = 133⅓ lb.

Table V

PRODUCTION OF PALM OIL AND KERNELS AND PRICES OF PALM OIL

(long tons, as declared by estates)

Month	Production of Palm Oil (long tons)		Production of Palm Kernels (long tons)		Average Price per Ton of Palm Oil*		
	1956	1957	1956	1957	1957		
					£	s.	d.
January -	3,712	3,527	1,038	921	90	10	0
February -	3,697	3,572	1,013	926	91	16	9
March -	4,520	4,828	1,229	1,225	91	15	0
April -	4,105	4,585	1,069	1,168	89	16	7
May -	4,364	4,689	1,096	1,096	86	15	0
June -	5,263	5,140	1,310	1,203	86	14	4
July -	4,977	5,823	1,210	1,480	85	0	0
August -	5,303	5,355	1,383	1,445	82	19	0
September -	5,098	5,666	1,285	1,408	82	2	0
October -	5,387	5,896	1,411	1,465	82	7	0
November -	4,842	5,070	1,233	1,341	78	14	0
December -	4,654	4,356	1,208	1,103	78	9	0
Total -	55,922	58,507	14,495	14,781	£85	11	8

* F.O.B.

Table VI

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE FEDERATION OF MALAYA

(tons)

Month	Copra Production						Coconut Oil Production *		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957
January	2,728	2,473	7,808	8,454	10,536	10,927	8,247	8,272	5,197	5,160
February	2,713	2,339	8,457	5,916	11,170	8,255	7,369	7,919	4,612	4,803
March	3,032	2,725	6,463	5,510	9,495	8,235	8,459	8,677	5,242	5,340
April	2,878	2,849	7,188	6,975	10,066	9,824	7,916	6,618	4,855	4,245
May	2,813	3,098	11,015	8,185	13,828	11,283	8,729	6,614	5,434	4,163
June	3,133	3,513	9,457	7,235	12,590	10,748	9,193	8,541	5,731	5,405
July	3,860	4,105	10,971	10,456	14,831	14,561	9,410	8,879	5,849	5,649
August	4,140	3,488	14,000	10,865	18,140	14,353	11,447	8,775	7,132	5,528
September	3,986	3,195	12,896	7,948	16,882	11,143	9,567	8,704	6,028	5,470
October	3,807	2,880	10,605	9,935	14,412	12,815	9,403	9,174	6,263	5,753
November	2,992	2,591	8,291	5,285	11,283	7,876	9,195	8,347	5,739	5,231
December	2,927	2,587	7,804	7,671	10,821	10,258	9,438	5,988	5,726	3,941
Total	39,009	35,843	115,045	94,435	154,054	130,278	108,373	96,508	67,808	60,688

Notes:—1. The above table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills, respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

* Includes both refined and crude oil.

Table VII

SINGAPORE PRICES OF VARIOUS AGRICULTURAL PRODUCTS

(dollars per pikul †)

Date	Copra, Sundried	Coconut Oil *	Pepper, F.A.Q. Muntok White	Pepper, Gen. Muntok White	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
4-11-57	26.00	45.50	106.00	116.00	55.00	9.37	16.50	9.50
11-11-57	26.25	45.75	104.50	114.50	52.00	9.37	16.50	9.50
18-11-57	27.25	46.50	104.50	105.50	46.50	9.37	16.50	9.75
25-11-57	27.25	47.00	98.00	108.00	53.00	9.37	16.00	9.50
2-12-57	30.00	50.00	95.00	105.00	53.00	9.25	16.00	10.50
9-12-57	31.00	54.00	106.00	116.00	53.00	9.25	18.00	13.00
16-12-57	31.00	55.00	101.00	111.00	52.00	9.25	16.00	14.00
23-12-57	30.50	52.50	100.00	110.00	53.00	9.25	17.50	14.50
30-12-57	29.50	52.00	102.00	112.00	53.00	9.25	17.50	14.25
6- 1-58	29.50	50.00	99.00	109.00	50.00	9.25	17.00	14.00
13- 1-58	29.50	50.00	98.50	108.50	53.00	9.25	17.00	13.00
20- 1-58	29.50	50.00	103.00	113.00	53.00	9.12	17.00	12.50
27- 1-58	30.50	50.00	100.00	110.00	53.00	9.00	17.00	12.50

† 1 pikul = 133⅓ lb.

F.O.B. in second-hand drums.

‡ Nominal.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

Table VIII

MALAYAN AGRICULTURAL EXPORTS,

JANUARY TO DECEMBER, 1957

Product	Net Exports in Tons		
	Year 1955	Year 1956	Year 1957
Arecanuts	13,679	11,228	9,625
Coconuts, fresh †	72,140	34,779	37,466
Coconut oil	91,176	103,132	100,031
Copra	75,076 *	82,549 *	71,718 *
Copra cake	56,404 *	66,174 *	73,208 *
Gambier, all kinds	66	96	3
Palm Oil	52,832	55,252	56,728
Pineapples, canned	27,756	30,377	37,671
Sago, flour	23,053	21,483	19,581
Sago, pearl	5,483	4,276	4,021
Sago, raw	18,709 *	18,522 *	14,006
Tapioca, flake	475	260	403
Tapioca, flour	3,979 *	3,753 *	1,573 *
Tapioca, pearl	5,470	5,630	5,222

† hundreds. * net imports.

METEOROLOGICAL SUMMARY, MALAYA, JANUARY, 1958

Locality	Air Temperature Degrees Fahrenheit: Means of A. Max.	Means of B. Min.	Means of A and B	Absolute Extremes: Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	Earth Temperature: At 1 foot °F	At 4 feet °F	Rainfall: Total in.	Total mm.	Most in a day Amt. in.	Number of Days: Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Bright Sunshine: Total hr.	Daily Mean hr.	Per cent.
Ipoh, Perak	92.0	71.9	81.9	96.2	66.8	79.1	74.4			4.95	125.7	1.70	9	9	1			238.35	7.69	
Kuala Lumpur, Selangor	91.3	72.5	81.9	94.1	68.6	86.3	75.2			7.28	184.9	2.02	18					—	7.58	
Sitiawan, Perak	89.2	72.3	80.7	92.6	68.9	82.2	75.0	83.9	84.6	5.34	135.6	3.15	8	7	4	3		239 50	7.73	
Kuantan, Pahang	86.3	70.6	78.5	90.1	64.5	79.1	75.1	79.9		17.08	433.8	4.98	15	13				226.80	7.32	
Bayan Lepas, Penang	89.3	73.7	81.5	92.8	70.4	82.0	76.0			1.55	39.4	0.52	7	7	1			264.90	8.55	
Malacca	89.9	73.6	81.7	93.1	70.4	87.9	75.6			3.59	91.2	1.68	11	11	2			251.85	8.12	
Mersing, Johore	84.1	73.8	78.9	86.4	68.8	78.3	78.2			6.11	155.2	1.70	13	11			1	248.00	8.00	
Alor Star, Kedah	91.1	71.8	81.5	94.3	67.2	85.8	76.2			0.85	21.6	0.49	2	2				281.20	9.07	
Kota Bharu, Kelantan	85.1	73.3	79.3	87.2	69.4	80.8	79.7	81.9	82.7	3.92	99.6	1.45	11	8		2		229.55	7.40	
K. Trengganu, Trengganu	84.1	73.0	78.5	86.1	69.2	81.2	77.7			2.93	74.4	1.02	12	12				238.10	7.68	
Singapore	87.3	73.8	80.5	91.0	70.0	80.4	76.3			7.53	191.3	2.51	14	12				219.35	7.07	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	73.0	64.4	68.7	75.9	45.5	68.4	62.2			59.1	150.1	1.20	11	10				173.60	5.60	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, FEBRUARY, 1958

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A.	B.	Means of A and B	Highest		Lowest														
	Max.	Min.										Amt.								
Ipoh, Perak	94.3	72.1	83.2	98.3	69.2	91.8	75.9			in. 3.74	mm. 95.0	in. 2.11	7	6	3			hr. 235.55	hr. 8.41	
Kuala Lumpur, Selangor	92.3	72.5	82.4	94.4	68.2	88.4	75.5			7.43	188.7	2.98	12	8	4			220.60	7.88	
Sitiawan, Perak	89.9	73.0	81.5	91.9	70.9	87.0	76.0	84.4	84.9	4.85	123.2	1.80	9	9	1	1		258.15	8.51	
Kuantan, Pahang	86.6	70.5	78.5	88.5	65.0	83.6	74.2	80.3		2.54	64.5	0.74	11	10		1		177.40	6.33	
Bayan Lepas, Penang	90.2	74.5	82.3	92.6	71.2	88.0	77.3			1.85	47.0	1.04	7	5	3			262.70	9.38	
Malacca	89.7	73.7	81.7	92.2	68.4	85.5	75.6			5.36	136.1	2.09	11	8	3			191.20	6.83	
Mersing, Johore	83.9	74.3	79.1	86.8	68.0	79.0	79.0			7.63	193.8	1.73	12	12			1	173.70	6.20	
Alor Star, Kedah	93.9	71.4	82.7	98.6	66.5	90.6	76.0			4.11	104.4	3.20	4	4				263.25	9.40	
Kota Bharu, Kelantan	86.1	72.8	79.5	89.0	68.0	80.0	79.1	84.1	84.3	1.44	36.6	0.70	8	6				231.65	8.27	
K. Trengganu, Trengganu	84.9	72.6	78.7	86.3	67.8	82.4	78.0			5.06	128.5	2.31	8					236.95	8.46	
Singapore	87.2	74.3	80.7	96.0	70.5	81.0	76.5			6.83	273.5	2.29	13	11	2			148.35	5.30	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	73.9	53.8	63.9	78.2	41.4	70.9	60.8			2.59	65.8	1.56	7	4				176.75	6.31	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, MARCH, 1958

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F	° F			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	94.5	74.2	84.3	99.1	71.0	87.2	77.0			4.98	126.5	1.18	10	9	12			225.90	7.29	
Kuala Lumpur, Selangor	92.1	73.9	83.0	94.3	70.9	87.0	76.9			12.18	309.4	2.49	21	18		3		215.40	6.95	
Sitiawan, Perak	90.6	73.5	82.1	93.0	70.4	86.5	76.8	85.0	85.6	2.56	65.0	0.56	13	11	6	1		228.60	7.39	
Kuantan, Pahang	89.5	71.9	80.7	93.0	66.6	85.1	76.0	83.7		2.83	71.9	0.83	9	9	3	2		222.50	7.18	
Bayan Lepas, Penang	90.7	75.1	82.9	93.0	71.3	87.0	79.0			4.49	114.0	2.26	12	9	6			236.10	7.62	
Malacca	90.0	74.2	82.1	91.8	71.5	87.6	76.2			7.08	179.8	1.28	17	15	4			207.40	6.69	
Mersing, Johore	86.6	72.6	79.6	90.3	69.8	80.0	76.2			5.53	140.5	1.95	14	14	2			222.40	7.17	
Alor Star, Kedah	94.9	72.8	83.9	97.4	68.0	89.6	77.2			3.22	81.8	0.86	12	19	2			274.90	8.87	
Kota Bharu, Kelantan	88.5	73.2	80.8	93.0	67.6	85.0	79.8	87.8	86.5	4.12	104.6	2.57	8	6		4		273.95	8.84	
K. Trengganu, Trengganu	86.8	73.4	80.1	90.0	69.2	83.0	78.2			8.25	209.6	5.07	9	9		1		280.05	9.03	
Singapore	89.7	74.9	82.3	92.5	73.0	84.0	76.5			4.22	107.2	1.39	10	7	5			194.45	6.27	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	75.5	55.6	65.5	79.0	44.4	72.5	61.4			3.81	96.8	0.62	20	12				170.05	54.9	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, APRIL, 1958

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall							Bright Sunshine		
	Means of			Absolute Extremes									Number of Days						
	A.	B.	Means of A and B	Highest		Lowest		At 4 foot	At 1 feet	Total	Most in a day						Total	Daily Mean	Per cent.
	Max.	Min.		Highest Max.	Highest Min.	Lowest Max.	Lowest Min.	° F	° F		Amt.	0.04 in. or more	0.10 in. or more	Thunderstorm	Fog morning	34+ force or more			
Ipoh, Perak	94.6	74.8	84.7	96.5	71.8	90.9	77.4			11.01	279.7	2.35	18	16	10		248.55	8.28	
Kuala Lumpur, Selangor	93.0	74.4	83.7	95.4	72.1	89.2	76.8			13.24	336.3	2.69	17	14	12	4	230.00	7.67	
Sitiawan, Perak	91.5	74.5	83.0	93.9	12.8	84.9	76.4	86.1	86.2	3.45	87.6	1.12	12	9	3		257.30	8.58	
Kuantan, Pahang	90.7	72.9	81.8	94.4	67.1	86.3	76.6	85.6		2.12	53.8	0.81	11	7	3	1	241.35	8.05	
Bayan Lepas, Penang	89.9	76.2	83.1	91.4	72.0	87.6	78.8			11.30	287.3	6.63	15	11	8		261.60	8.72	
Malacca	90.4	74.9	82.7	92.9	73.1	87.0	76.7			6.22	158.0	1.84	12	10	4		230.85	7.69	
Mersing, Johore	90.0	73.5	81.7	92.2	70.8	87.0	79.0			2.74	69.6	0.89	6	6			269.10	8.97	
Alor Star, Kedah	96.2	74.2	85.2	99.2	71.6	94.2	76.7			3.25	82.6	2.03	12	9	1	2	284.20	9.47	
Kota Bharu, Kelantan	91.0	74.6	82.8	93.2	71.5	88.8	77.7	91.4	89.7	1.24	31.5	0.70	7	4			304.20	10.14	
K. Trengganu, Trengganu	89.6	74.0	81.8	91.6	69.7	87.2	76.4			3.05	77.5	1.44	8	8			296.15	9.87	
Singapore	90.8	75.5	83.7	93.2	71.6	88.3	77.8			3.25	82.6	1.22	6	5			215.60	7.19	
HILL STATIONS																			
Cameron Highlands, Tanah Rata, Pahang. (3750 ft.)	75.8	55.6	65.7	78.5	45.5	72.0	63.0			97.3	247.1	1.72	20	19			159.45	53.1	

Compiled from returns supplied by the Malayan Meteorological Service.

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„ 18, No. 10
„ 20, No. 10
Vol. 21, No. 6
„ 22, No. 3
„ 23, Nos. 3 & 6
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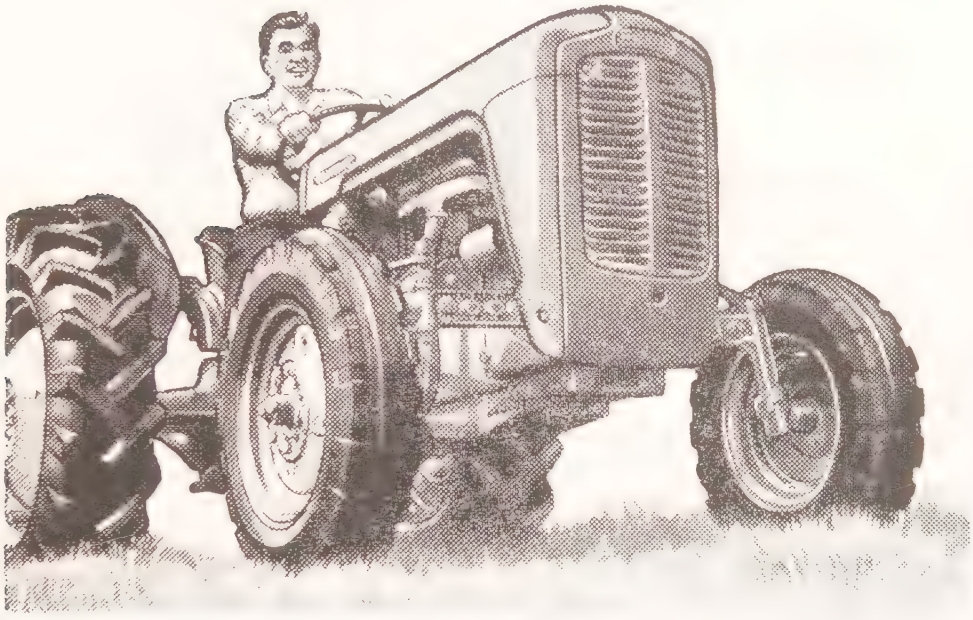

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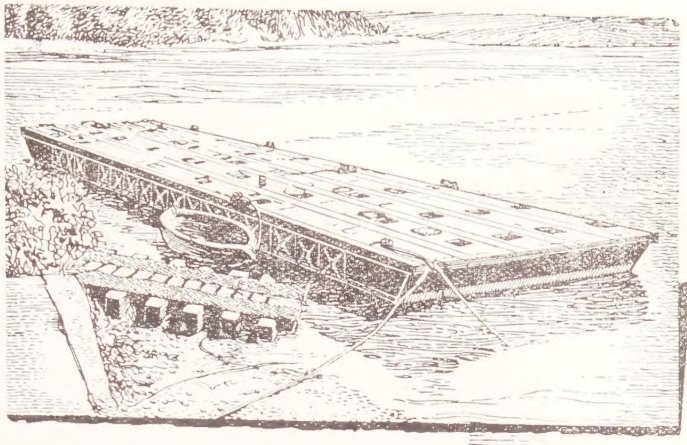

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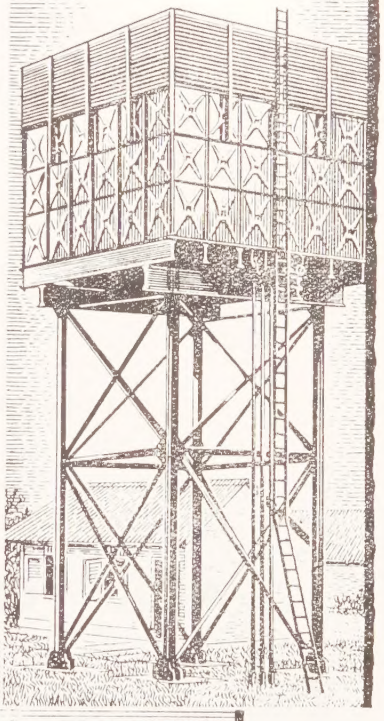

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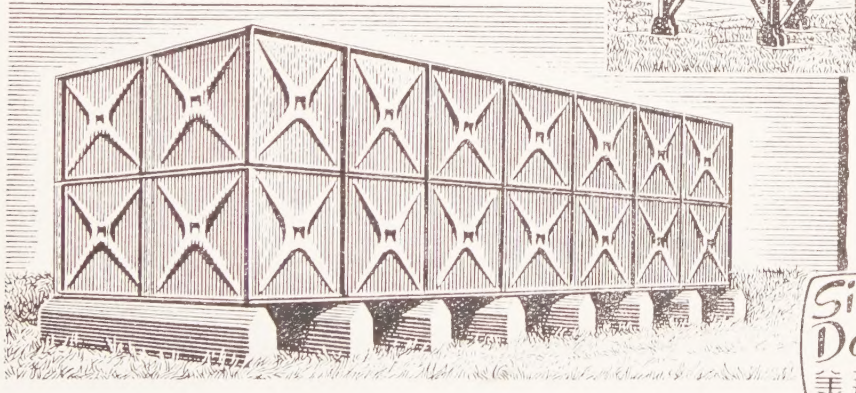

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Correspondence concerning the experiments at any of these Stations should, if it originates in Malaya, be addressed to the State Agricultural Officer, concerned; correspondence originating in any other country should be addressed to the Director of Agriculture, Federation of Malaya, Kuala Lumpur.

Wet Padi.

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Dry Padi.

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Tea.

Federal Experiment Stations, Cameron Highlands and Serdang.

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Federal Experiment Stations, Serdang, Selangor, and Jerangau, Trengganu.

Coconut.

Federal Experiment Station, Telok Bharu, Perak, and Coconut (Rehabilitation) Station, Sungei Sudah, Muar, Johore.

Cacao.

FEDERAL EXPERIMENT STATIONS. Serdang, Selangor, and Jerangau, Trengganu.

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Pineapple.

Jalan Kebun, Selangor, and Alor Bukit, Johore.

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Federal Experiment Station, Serdang, Selangor; Degong, Perak; and Sungei Ruan, Pahang.

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